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EDITORIAL.

The Agricultural Conference, 1930. The Second Inter-Departmental Agricultural Conference was held at Kuala Lumpur from 27th October to 1st November inclusive. The event provided a unique opportunity for the exchange of ideas between the officers of the Department of Agriculture, the Rubber Research Institute of Malaya, the Co-operative Department and the Veterinary Department.

It is perhaps early to venture a survey of the result of the Conference; the large number of subjects discussed and the diversity of angles from which each subject was reviewed by the departments, renders further consideration desirable. The resolutions passed and the numerous suggestions for future work will be considered by the appropriate officers in the coming months and eventually translated into action.

Such interchange of views between departments having much in common is of great value. The recent Conference cannot but lead to greater liaison between the departments concerned, which will necessarily result in greater efficiency and more effective service to the public.

The account of the Conference included in this number is necessarily brief, but it may enable the reader to realise the diversity of the subjects considered and of the value of the discussions to those whose duty it is to investigate such agricultural problems and to ensure the practical application of the result of research work of this nature. The publication in subsequent numbers of this Journal of certain of the conference papers will supplement the present account and will, it is thought, prove of value to planters in Malaya.

Technical Reports for 1929. The diffuse duties of an efficiently equipped department of agriculture make the preparation of an annual report of the head of department one of some difficulty. The writer of such a report can but give an outline of the activities within his department and is thus apt to do less than justice to the work of his officers. In so doing he is almost certain to omit much detailed information of value to the country served by his department. Completed research work is usually adequately described in the form of special articles and reports published from

time to time and in one form or another; but even when this is accomplished there remains much information of a miscellaneous nature which is lost to the public if it is not included in an annual report.

Hitherto, the system in this Department has been to publish the collected Annual Reports of Heads of Divisions in a number of *The Malayan Agricultural Journal*. The reorganised form of this Journal, however, renders such a course undesirable as it would interfere with the continuity of the present features of the Journal and would thereby delay the publication of other important articles. The system has, therefore, been adopted of publishing the Annual Reports of Technical Officers in the form of a Special Bulletin. These reports in respect of the year 1929 will be in the hands of subscribers in this form during the present month.

The work of the Department of Agriculture, S.S. & F.M.S. is divided into that performed by the technical staff, stationed as a rule at headquarters in Kuala Lumpur, and that of the field staff, stationed throughout the country. This latter staff, under the supervision of a Chief Agricultural Field Officer stationed at headquarters, is mainly engaged in the application of the results obtained by the technical officers to the conditions peculiar to the territory served by each. These duties are generally designated as the Extensional Services.

In the past, it has been the practice to condense the annual reports of the field officers in the form of the report of the Chief Agricultural Field Officer. This officer experiences the same difficulty in presenting an adequate account of the activities of his Division as are experienced by the Director in preparing a report on the work of the Department. In order, therefore, that the field work may be presented to the public in sufficient detail, the annual reports of the field staff will also be published as a Special Bulletin. This publication, in respect of the year 1929, is already in the press and it is hoped, will be distributed before the end of this year.

These two publications are recommended to the public with the assurance that they render an adequate account of the work of the Department and make it possible for the reader to obtain an intimate and valuable insight into the progress of the agriculture of Malaya.

Rainfall. With the exception of padi, the major crops of Malaya demand a heavy annual rainfall fairly well distributed throughout the year. The success of rubber, coconuts, oil palms and pine-apples, for instance, is very largely accounted by this even precipitation. Padi and most annual crops are grown more successfully in situations where the seasons are more defined. Although Malaya experiences dry spells, it is difficult to predict the months in which they will occur in any year. In view of the desirability of improving our present areas under padi—a matter largely connected with water supply—and of developing new areas, in addition to the increased attention given to the development of new agricultural industries, a more exact knowledge of rainfall is essential,

Rainfall and other meteorological data has been recorded at various stations in Malaya for many years past and are published in *The Malayan Agricultural Journal* and elsewhere, but no serious attempt appears to have been made, hitherto, to analyse the data so obtained in order that agriculturists may know to what extent seasons exist and what the climatic variations are in different parts of the country. At our request, Mr. Stewart, Superintendent of the Meteorological Branch, Malaya, has prepared an article which is included in the present number, from which we can envisage the climatic variations throughout Malaya. The article merits more than passing attention because it has a direct bearing on the crops grown in the country, and also because it should enable the planter to organise his work of cultivation, planting and draining in closer conformity with the weather conditions throughout the year.

Advertising. The pages of advertisements which appear monthly in this Journal are not designed merely to provide revenue for the Journal, but to bring before readers the range of agricultural equipment which is at their command. With this object in view, an endeavour has been made to confine advertisements to those of an agricultural nature. Furthermore, advertisers are encouraged to change their advertisements at frequent intervals so that the scope and interest of these pages are increased to the reader. While this policy is against the financial interests of the Journal, we believe it can be made to pay because readers will thereby make a habit of reading the advertisements as methodically as they read other matter in the Journal.

Technical periodicals are frequently purchased—not mainly for the articles they contain—but because the reader finds it necessary to keep himself well informed of improvements effected on the equipment side of his profession. Advertisements are frequently the only form of shop window possessed by manufacturers and dealers in such goods as agricultural machinery, fertilisers, insecticides and fungicides, and it is for this reason that we hope that our readers may benefit by the advertisements contained in *The Malayan Agricultural Journal*.

Advertisers frequently find it difficult to gauge the effectiveness of their advertisements. Readers will therefore render a service to both the advertisers and the Journal if, in replying to advertisements, they mention the periodical which induced their enquiry.

THE RAINFALL OF MALAYA

BY

C. D. STEWART, B. Sc.,
Superintendent, Meteorological Branch,
Survey Department, F.M.S. and S.S.

In equatorial regions the annual variation of temperature is insignificant and any division of the year into seasons is based on the relative amounts of rainfall experienced at different times of the year. Wet and dry seasons take the place of cold and hot seasons and the variation of rainfall throughout the year comes to have an importance similar to that which temperature variation has in middle latitudes.

The significance of the terms "wet" and "dry", as applied to seasons in Malaya is, however, entirely relative. There is no part of the year, in any district, in which excessive rainfall may not be experienced; and similarly, there is no part of the year in which, for a time at least, rainfall may not be slight. The seasonal characteristics give the normal experience and also express very strong probabilities. Moreover, the average monthly rainfall for almost any Malayan station in its "dry" season would be regarded as a considerable amount of precipitation at any station in temperate latitudes. The driest month at Singapore, for example, is May, with an average rainfall of 6.65 inches.

The type of seasonal variation of rainfall in the Malay Peninsula is not uniform over the country. The characteristic variation of the East Coast is totally different from that of the West Coast and the interior. One part of the West Coast, again, has a seasonal variation which is peculiar to itself, while the characteristics of the inland variation extend everywhere else to the West Coast. There are thus three distinct regions each with its characteristic seasonal variation. The first region is along the East Coast and probably extends inland for twenty miles or so; such observations as are available show that this type of variation is very rapidly replaced as we leave the East Coast by the type of the inland region, which includes the whole of the Peninsula with the exception of the East Coast, and the previously mentioned portion of the West Coast. This last named stretch of coast, with a narrow strip of land behind it, forms the third region.

The differences in the regional characteristics, and in fact, the seasonal variations themselves, are due to the changes in the main wind currents flowing over the Peninsula. A strong north-easterly wind commences late in October or during November and continues until some time in March, and is known as the North East Monsoon, although it seems probable that it is due to a southerly movement of the north-east trade wind of the China Sea rather than to what is usually understood as a monsoon effect. From May to August a light

south-westerly wind blows. This wind is not strong and at the surface is entirely subordinate to the fresh land and sea breezes which are experienced by night and day respectively; nevertheless, in the upper air the general drift is from the south-west. This again is known, though perhaps not so generally, as the South-West Monsoon. This current, however, does not blow across the whole length of the Peninsula like the North-East Monsoon, but only extends southward to the region of Malacca on the West Coast and to Pekan on the East Coast. South of this the prevailing direction is South East, the air-stream arriving from south of the Equator. The interval between the cessation of the North East Monsoon and the commencement of the South West Monsoon varies in length by a few days but is usually about eight weeks and there is a similar interval between the end of the South West Monsoon and the beginning of the North East Monsoon. These transition intervals are long enough to be regarded as "seasons", so that the Malayan year is divided more or less naturally into four seasons, namely, the North East Monsoon, the South West Monsoon and the shorter seasons separating the monsoons, when there is no real prevailing wind current but a more or less stagnant atmosphere. The rainfall does not everywhere show a seasonal variation corresponding to the seasons as specified in this way by their wind characteristics, but over the greater part of the Peninsula, including the whole of the interior, there is a well defined variation with two maxima and two minima whose times closely follow those of these wind seasons.

The three principal "regions" have already been defined above. In the East Coast region the rainfall follows the North East Monsoon, reaching its maximum intensity about the middle of the monsoon, in December, and its minimum in July. There is some evidence that the actual times of maxima and minima become slightly later as we go south from Kota Bharu, but this change is not sufficiently large to show itself with any clearness in the monthly totals. The broad seasonal variation shows in the monthly totals as this single oscillation without any secondary maxima or minima.

In the West Coast region, over a short length of coast about Malacca, the variation is exactly the reverse, the maximum intensity being experienced about August and the driest month being January. In this case the main variation consists of a single oscillation in twelve months, the maximum and minimum occurring as stated. The decrease of rainfall from August to January is, however, interrupted to some extent by a slight but definite increase for October, which corresponds with a very decided maximum at this time at all inland stations. The length of coast along which this type of annual variation is experienced appears to be limited. At Port Dickson and Malacca it is very well defined but further south at Batu Pahat and Kukub it disappears and we find the variation common to the interior and the northern part of the West Coast, to be described below. The observations available for this part of the coast are somewhat restricted, both with regard to the number of stations and to the number of years for which observations exist, but it seems reasonably

clear that the Johore coast does not experience the same seasonal rain as Malacca. It will be understood from this that by "West Coast variation" is meant a variation which is experienced only on the West Coast, but not one which is typical of the West Coast. This particular type of variation, also its limited extent, can probably be explained by the fact that it is in this area that the south westerly winds of the northern half of the Peninsula meet the south-easterly winds of the southern half. In the middle of the year, when this takes place, the south easterly current is distinctly warmer than the south westerly one as is shown by the air temperatures at Singapore being, on the average, about 3°F. higher than those at Malacca at this time of year. The warmer, and consequently lighter, air rises over the denser south westerly current and thus produces the rainfall experienced at this season.

The third region, comprising the whole of the interior and the northern and southern parts of the West Coast, has a seasonal variation in which the middle of the North East Monsoon and the middle of the South West Monsoon are times of comparatively low rainfall while the transition seasons between the monsoons are both wet periods. The curve of rainfall for the year thus shows two maxima, about April and October, and two minima, about January and July. The times of maxima and minima vary to some extent from place to place, but the variations do not follow any simple law and only appear clearly in a harmonic analysis of the seasonal changes of rainfall. It is of interest to note that Singapore belongs quite definitely to the East Coast region with regard to rainfall though the seasonal variation is itself comparatively small.

The summary of Malayan rainfall conditions outlined in the preceding paragraphs has dealt only with the general character of the seasonal changes which are experienced in different areas and not at all with the actual distribution of rainfall. In the actual quantities of rain measured there are wide variations, even over relatively short distances, and between stations at which the seasonal changes are similar in type. It is necessary, therefore, in order to complete such an account, to give a reasonably comprehensive table of the rainfalls measured at different stations. The data available are by no means uniform, either in the distribution of stations or in the number of years for which records are available. In Perak, for example, there are many more stations than those shown on the map and only a fairly representative selection has been included; Kelantan and Trengganu, on the other hand, each have only one station with any useful series of records. The Trengganu records, further, only include five years' observations and would not be quoted in any paper such as the present one but for their being the only ones available; whereas in Perak no station included here has less than 20 years' observations and many have been observing for more than 40 years. In Pahang, again, the data available are exiguous although such stations as do exist have records extending, for the most part, over a considerable number of years. That such extensive areas should be without any adequate rainfall records is largely due to the undeveloped nature of much of the country, covered as it is with primitive jungle.

TABLE I.

AVERAGE MONTHLY RAINFALL AT EAST COAST STATIONS.

STATIONS.	MONTHLY RAINFALL TOTALS.													Seasonal percentages of annual rainfall.		
	No. of years.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Nov. to Feb.	Mar. Apl. Sept. Oct.	May to Aug.
		Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	%	%	%
7. Kota Bharu ...	23	10.29	6.66	6.99	**4.51**	6.17	6.40	5.59	6.74	8.64	11.47	22.95	**27.49**	123.90	54	26	19
8. Kuala Trengganu ...	5	**9.22**	12.75	**16.81**	6.11	5.49	5.23	**3.22**	4.07	6.88	16.68	**34.31**	28.54	149.31	57	31	12
26. Kuantan ...	33	15.22	9.05	8.35	6.28	6.62	**5.61**	5.64	6.22	7.78	10.83	13.46	**23.41**	118.47	51	28	21
25. Pekan ...	35	16.32	12.39	8.72	6.81	6.45	5.19	**4.42**	6.66	6.93	10.69	16.70	**28.45**	129.73	56	27	17
29. Rompin ...	13	23.68	14.39	11.45	6.13	**5.54**	5.70	5.58	7.05	6.87	8.59	16.32	**26.74**	138.04	59	24	17
50. Mersing ...	11	16.94	9.07	7.26	**5.08**	6.31	6.11	6.26	7.46	5.80	8.36	12.64	**20.99**	112.28	54	24	22
51. Singapore ...	52	9.88	**6.62**	7.40	7.64	6.65	6.85	6.77	7.95	6.77	8.07	9.92	**10.55**	95.07	41	30	29

A reference map is given from which the individual stations can be identified by their numbers. The number of years for which observations are available is shown for each station in the second column of the tables. Maximum and minimum monthly rainfalls, both principal and secondary, are printed in heavy type, in order to show clearly the type of seasonal variation for each station. The data for the 51 stations are brought together in three tables as it is natural and convenient to consider separately the stations of the East Coast, those of the West Coast and those of the interior.

In Table I the typical East Coast variation appears clearly at all stations except Kuala Trengganu. Ignoring this station for the moment, the heaviest month's rainfall is found everywhere in December. The minimum occurs in different months being earliest in the extreme north and latest at the intermediate stations. The magnitude of the variation is of some interest. While in Singapore the wettest month has less than twice the rain of the driest (if we may use this adjective) at Pekan the maximum month's rainfall is more than six times the minimum. Of this group of stations, Singapore has the lowest wet season rainfall and the highest dry season rainfall. In considering seasonal variations of this type, where the figures represent mean monthly totals, as distinct from mean daily values, it is necessary to bear in mind that for comparison the February figures require to be increased by 11 per cent. on account of the extra three days in January and March. The Kuala Trengganu seasons appear to show the characteristics of the inland rainfall rather than those of the East Coast. It is difficult to be certain about a point of this nature with only five years' records, especially when an abnormal monsoon rainfall such as 1926—1927 is included, but the figures are so regular that it is almost more difficult not to accept the succession of values as being representative, whatever the absolute totals may eventually prove to be. But that Kuala Trengganu, in spite of this apparent divergence from the general East Coast characteristics, has the same main seasons, appears clearly from the last three columns, in which are given for each station the percentages of the years' rainfall which are experienced during the season of the North East Monsoon, the season of the South West Monsoon and the two transition periods combined. The division into three periods of equal length naturally gives only an approximation to the true seasonal periods but this does not affect the comparison.

From the right section of Table I it appears that at Kuala Trengganu, as at the other East Coast stations with the exception of Singapore, considerably more than half the year's rainfall falls between the beginning of November and the end of February and from one-fifth to one-tenth between the beginning of May and the end of August. In the case of Singapore the general features are the same but the variation is much smaller in extent, the difference between the maximum and minimum rainfalls being comparatively small.

The annual rainfall along the East Coast is everywhere relatively heavy with the exception of Singapore. The Kuala Trengganu totals cannot be taken as representative as the five years' records which are available include at least

TABLE II.

Average Monthly Rainfall at West Coast Stations.

STATIONS.	MONTHLY RAINFALL TOTALS														Seasonal percentages of annual rainfall.		
	No. of years	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Nov. to Feb.	May June July Aug.	May to Aug.
		Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	%	%	%
1. Pulau Langkawi ...	13	**1.39**	1.72	5.31	7.32	**10.24**	**7.93**	8.55	11.19	12.19	**13.65**	7.48	3.71	90.68	16	42	42
2. Perlis ...	21	**1.77**	2.08	5.47	7.22	**8.67**	**6.65**	8.34	**8.60**	**11.09**	10.53	8.29	4.13	82.84	20	41	38
3. Alor Star ...	23	2.47	**2.08**	5.93	8.73	**11.09**	**7.83**	7.88	10.81	**13.45**	11.70	7.98	5.79	95.74	19	42	39
4. Sungei Patani ...	17	3.64	**2.96**	5.91	**9.17**	9.00	**4.79**	6.69	7.55	12.29	**15.71**	10.82	5.35	93.88	24	46	30
13. Penang ...	39	3.82	**2.91**	4.96	6.93	**10.79**	**7.68**	8.35	12.84	16.14	**16.61**	11.81	4.96	107.53	22	41	37
12. Parit Buntar ...	42	5.26	**4.33**	7.56	**8.86**	6.95	5.09	**5.08**	6.93	9.50	**11.58**	10.65	6.90	88.69	31	42	27
21. Pangkor ...	26	9.32	6.93	**6.85**	**7.34**	6.64	4.99	**4.98**	5.26	9.48	12.85	**13.03**	10.87	98.53	41	37	22
20. Bagan Datoh ...	12	8.21	**6.17**	6.43	**7.31**	5.03	**3.16**	3.24	4.75	7.82	9.02	**10.64**	8.26	80.04	42	38	20
31. Kuala Selangor ...	43	7.31	**4.39**	4.82	**5.78**	4.96	3.76	**3.67**	4.55	5.71	9.03	**9.33**	9.01	72.32	41	35	23
32. Klang ...	43	7.97	**5.96**	7.08	**8.58**	6.50	4.49	**4.46**	5.76	6.10	9.40	**10.25**	10.15	86.70	40	36	24
35. Kuala Langat ...	42	7.49	**4.46**	4.66	**6.98**	5.60	**5.15**	5.56	6.44	7.39	9.28	**10.90**	10.33	84.24	39	34	27
39. Port Dickson ...	30	4.88	**3.76**	4.44	8.09	6.60	7.12	7.71	10.02	9.09	**11.32**	9.84	7.88	90.75	29	25	36
41. Malacca ...	35	**3.23**	3.51	4.41	6.85	6.58	7.76	8.23	**10.71**	8.35	9.77	8.31	6.18	83.89	25	34	41
44. Muar ...	13	6.41	**3.79**	6.43	**8.37**	7.14	7.01	**6.56**	7.55	**9.20**	8.27	8.16	5.49	84.38	31	38	31
45. Batu Pahat ...	14	8.40	**6.15**	8.47	**8.51**	6.65	6.64	**6.27**	8.15	8.69	**9.24**	8.63	5.67	91.47	31	38	31
47. Kukub ...	8	10.35	**7.79**	**10.26**	9.26	7.35	8.23	**6.31**	8.71	9.73	**13.97**	8.88	8.59	109.43	32	39	29

one exceptionally wet year and an extension of the term of years will almost certainly reduce the average values to a considerable extent. The centre of heaviest rainfall is probably in the neighbourhood of Rompin with a slight diminution as we go north from there and a decided diminution as we go south. The average annual rainfall in this region may be taken to be about 120 inches.

Table II gives the available data for the West Coast. The double variation during the year appears to a varying extent at all stations except Malacca. Port Dickson is classed with Malacca in this table as, although it shows two maxima and two minima, the principal variation is a single one similar in the main to the Malacca one. These are the only two stations to show this peculiarity and in the case of Port Dickson the maximum and minimum are later than at Malacca. It may be noted here that over the greater part of the Peninsula the effect of the North East Monsoon is very great, even where a maximum rainfall would appear to go with the seasons between the monsoons. In a number of cases the maximum appears in November rather than in September or October. The stations where this occurs are all along the limited stretch of coast between Pangkor and Kuala Langat, that is to say along the southern part of the coast of Perak and the coast of Selangor. At these stations, the seasonal percentages given in the last three columns of the table show that the North East Monsoon season has the greatest proportion of the year's rainfall and the South West Monsoon season the lowest. At other stations, apart from the two stations in the Malacca section, where the South West Monsoon season is the wettest, we find that the transition seasons have the greatest proportional rainfall.

The West Coast may thus be conveniently divided into four sections. The southernmost section is, on the whole, similar to the northern section but the seasonal proportions are somewhat different. It is worthy of note that in each section, in spite of the considerable variations of total rainfall from station to station, the seasonal proportions show very close agreement.

The monthly rainfall averages for inland stations given in Table III are noteworthy for the regularity with which the seasonal variation appears. Of the 28 stations shown, only two are without a July minimum. These two have minima in June that are very little lower than the July figures; in fact, if we allowed for the month of July being longer by one-twentieth than June the minimum would in each of these two cases appear in July as at every other station. The April maximum and the February minimum also appear very consistently. The minimum in October, however, is in many instances masked by the effect of the North East Monsoon. This is the case in South Perak and Negri Sembilan, where the maximum is in November and in South Pahang, where it appears in December and still more in South Johore, with maximum rainfall as late as January. It should be noted, however, that at all these stations a relatively heavy rainfall is attained by October, and at those stations where the maximum is reached in November there is generally very little excess over the October rainfall.

TABLE III.

Average Monthly Rainfall at Inland Stations.

STATIONS.	No. of years	MONTHLY RAINFALL TOTALS. Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Seasonal percentages of annual rainfall. Nov. to Feb.	Mar. Apl. Sept. Oct	May to Aug.
		Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	%	%	%
5. Baling ...	15	3.20	**2.80**	7.28	**9.62**	7.41	**5.00**	5.08	6.04	8.87	**13.15**	9.78	4.76	82.99	25	47	28
6. Kulim ...	21	6.88	**5.87**	11.61	**14.09**	10.07	6.32	**6.24**	8.05	11.06	**17.66**	16.36	10.06	124.27	31	44	25
9. Klian Intan ...	17	3.45	**2.89**	6.53	**8.87**	8.54	5.72	**5.41**	6.68	9.58	**13.72**	9.97	7.55	88.91	27	43	30
10. Grik ...	26	4.01	**2.97**	6.63	8.15	**8.77**	**5.29**	5.35	6.57	8.59	**12.74**	9.31	7.05	85.43	27	43	30
11. Selama ...	39	**9.02**	9.31	13.32	**17.93**	12.71	7.50	**7.09**	9.70	13.24	**19.23**	17.73	11.77	148.55	37	38	25
14. Lenggong ...	28	4.47	**3.58**	6.00	**7.70**	6.25	4.63	**4.04**	5.51	6.86	**10.73**	10.68	6.45	76.90	33	40	27
15. Taiping ...	42	14.07	**11.97**	17.23	**19.34**	13.13	6.89	**6.89**	9.03	12.39	**20.85**	18.81	15.58	166.18	36	42	22
16. Kuala Kangsar ...	42	5.61	**4.95**	7.25	**8.41**	5.99	3.96	**3.64**	5.33	7.42	**10.86**	10.76	7.07	81.25	35	42	23
17. Batu Gajah ...	42	8.35	**6.37**	9.20	**10.85**	7.85	5.12	**4.39**	6.56	8.25	10.73	**11.62**	10.19	99.48	37	39	24
18. Tapah ...	41	12.69	**9.68**	13.76	**15.83**	12.61	8.11	**6.50**	8.63	11.45	16.63	**17.19**	13.37	146.45	36	40	24
19. Teluk Anson ...	42	9.79	**7.25**	9.04	**9.74**	6.91	4.69	**3.92**	5.31	7.09	11.45	**11.81**	11.29	98.29	41	38	21
22. Kuala Lipis ...	33	9.11	**5.35**	6.22	8.37	**8.92**	7.64	**5.24**	7.25	8.44	**12.02**	11.28	11.51	101.35	37	34	29
23. Raub ...	30	8.83	**5.31**	5.82	**7.49**	5.87	5.22	**4.28**	5.60	7.57	10.30	**11.75**	9.67	88.01	40	36	24
24. Bentong ...	29	9.46	**5.82**	7.71	**8.56**	6.76	5.55	**3.55**	5.23	6.16	9.80	12.00	**12.05**	92.65	43	34	23
27. Sungei Lembing ...	17	14.38	**8.57**	12.16	10.66	**12.42**	7.47	**6.12**	8.72	10.74	14.20	16.12	**17.41**	138.97	41	34	25
28. Temerloh ...	30	7.83	**3.85**	6.03	**7.57**	6.62	4.28	**3.42**	5.61	6.52	9.27	9.70	**10.08**	80.78	39	36	25
30. Kuala Kubu ...	36	7.77	**5.45**	9.26	**11.90**	10.12	7.47	**6.36**	8.11	9.83	**16.15**	13.24	10.31	115.97	32	40	28
33. Kuala Lumpur ...	51	6.64	**6.04**	8.79	10.67	8.38	4.87	**4.18**	6.22	7.27	**11.13**	10.04	9.57	93.80	35	40	25
34. Kajang ...	38	**5.75**	6.39	9.22	**10.42**	8.00	5.03	**3.93**	5.66	6.84	**10.49**	10.19	9.07	90.99	35	40	25
36. Jelebu ...	39	4.72	**3.43**	6.40	**6.54**	5.54	3.75	**3.18**	3.89	4.52	7.19	**8.15**	7.37	64.68	37	38	25
37. Seremban ...	43	**5.28**	5.31	8.44	**10.36**	7.68	5.84	**4.85**	6.26	7.42	**10.26**	9.47	8.60	89.77	32	41	27
38. Kuala Pilah ...	33	6.81	**4.65**	6.97	**7.57**	5.60	4.72	**3.55**	4.17	4.78	8.08	**8.73**	8.55	74.18	39	37	24
40. Tampin ...	27	4.94	**4.12**	6.38	**8.21**	6.54	5.48	**5.15**	6.36	**6.31**	8.58	8.93	7.24	78.24	32	38	30
42. Segamat ...	14	12.16	**5.29**	7.44	**7.56**	5.73	5.04	**4.35**	4.84	6.04	**8.88**	8.80	7.79	83.92	41	35	24
43. Tangkak ...	13	9.21	**6.22**	8.73	**11.95**	6.53	6.78	**5.87**	6.53	7.51	**9.82**	8.76	6.73	94.64	33	40	27
46. Kluang ...	7	**13.75**	**6.47**	8.23	**9.51**	7.62	5.56	**3.98**	5.52	7.31	7.97	9.34	11.14	96.40	42	34	24
48. Johore Bahru ...	14	**14.00**	**8.71**	10.98	**11.17**	8.91	6.79	**6.18**	7.91	10.11	8.40	11.04	9.70	113.90	38	35	27
49. Kota Tinggi ...	12	**18.95**	**6.14**	8.85	**10.66**	10.09	10.48	**6.30**	8.28	9.02	11.62	12.70	13.02	126.11	40	32	28

The boundary between Perak and Pahang and Selangor and Pahang is a natural one formed by a mountain range generally more than 4,000 feet high and in many places 5,000 and 6,000 feet. The December maxima all appear at stations to the east of this range. In Johore where we find January maxima, there is no considerable mountain range and the seasonal variation here only departs in a minor degree from the typical East Coast variation.

The seasonal proportions of the annual rainfall, given in the last three columns of this table again give a useful summary of the district characteristics. The rainfall in the four months of the South West Monsoon (May to August), is at all stations low, being everywhere much below one-third of the year's total and in most cases only a quarter or less. The differences arise between the proportions occurring in the North East Monsoon season (November to February) and the four months forming the two intermediate seasons. In Pahang and Johore the larger proportion of the rain falls during the North East Monsoon whereas in all other districts it is the intermediate months which are the wettest. It may be noted that all these other districts lie to the west of the main mountain range.

The variations in rainfall from station to station, even in the same district, are sometimes very great. For example, Taiping has twice the annual rainfall of Kuala Kangsar. It is somewhat surprising to find, in these circumstances, that the seasonal division of the rainfall in these two places is practically identical. It will be seen that the districts separated in the table show within themselves fairly uniform seasonal characteristics, with only one or two exceptional stations in any district.

The stations whose rainfall observations have been quoted in the three tables given above are all low level stations. There are a few mountain stations in the Malay Peninsula but their records are better considered separately. The principal ones are given in Table IV. They are not shown on the station map but their positions are described in the text.

It is not necessary to make any detailed comments on the figures for the mountain stations. They are added principally to show what considerable differences can arise between places at comparatively short distances from one another, purely by reason of topographical peculiarities. Maxwell's Hill, for example, is about 4 miles east of Taiping, and "The Cottage" is about a mile further east again. These two stations have the heaviest rainfall recorded in Malaya.

Cameron's Highlands is on the border of Pahang and Perak a few miles south of the Kelantan border. Fraser's Hill lies practically at the point where the three states of Perak, Pahang and Selangor meet. These two stations have similar rainfalls, apparently not much greater in amount than at many of the low-level stations. The record period in each case is short and the figures given must not be regarded as established normals.

TABLE IV.

Average Monthly Rainfall at Mountains Stations.

STATIONS.	No. of years	Height.	MONTHLY RAINFALL TOTALS.													Seasonal percentages of annual rainfall.		
			Jan.	Feb.	Mar.	A pl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Nov. to Feb.	Mar. Apl. Sept. Oct.	May to Aug.
		Ft	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	%	%	%
Maxwell's Hill ...	27	3400	12.88	**9.61**	14.95	**20.07**	18.33	13.19	**9.25**	15.58	19.36	**26.30**	24.53	17.31	201.36	30	44	26
The Cottage ...	26	4558	14.15	**10.15**	17.35	22.00	**23.96**	16.69	**11.89**	17.60	23.79	**33.90**	31.60	21.43	244.51	32	39	29
Cameron's Highlands ...	6	4750	7.86	**5.34**	8.50	**13.82**	9.46	5.93	**4.18**	5.57	12.72	11.93	**14.57**	11.08	110.96	35	42	23
Fraser's Hill ...	8	4286	13.91	**6.78**	11.09	**11.78**	6.94	4.77	3.57	**3.28**	8.03	11.04	**15.39**	13.99	110.57	45	38	17

At all these high level stations the double annual oscillation is very well defined. The greater exposure to the North East Monsoon in the case of Fraser's Hill and of Cameron's Highlands again throws the late maximum into November, but the first two stations give typical examples of the ordinary inland seasonal variation.

A brief description of the distribution of rainfall over the Peninsula at different seasons is necessary to complete the account of Malayan rainfall. A series of monthly maps would be the ideal manner of presenting this aspect of the subject, but the variation throughout any one season is sufficiently limited to make one typical map reasonably adequate for each season. The only maps included, therefore are those for December, representing the North East Monsoon; for July, representing the South West Monsoon and for March representing the intermediate seasons. There are differences from month to month within the seasons, but the charts given may be taken as fairly representative.

During the North East Monsoon there is very heavy rainfall along the East Coast, which gets rapidly less as we approach the West Coast. There is however, in Perak a strip of country near the coast where the rainfall in this season is much greater than further inland, but still only about half of that along the East Coast.

During the South West Monsoon the rain is everywhere comparatively light but with the greatest rainfall along the North West and South West portions of the coast. There are no great differences inland.

The transition seasons have moderately heavy rainfall everywhere, but speaking generally, there is again a long strip of country including Kedah, Perak and Selangor with very heavy rain. These features are, however, better seen from the charts than from any verbal description.

To complete this account of the rainfall of Malaya it would be necessary to give data with regard to the duration of rainfall, but unfortunately, the records available are too meagre for this to be done at present. Records are now being obtained at selected stations, although the material necessary for a proper discussion will not be available for some years.

March

INCHES OF RAINFALL

July

INCHES OF RAINFALL

December

INCHES OF RAINFALL

MAP OF MALAYA
Miles 0 18 36 72 108 144 Miles
PERLIS
KEDAH
PATANI
PENANG
P. WELLESLEY
KELANTAN
TRENGGANU
PERAK
DINDINGS
PAHANG
SILANGORE
SEMBILAN
MALACCA
JOHORE
SINGAPORE
CHINA SEA
STRAITS OF MALACCA

A MAJOR PEST OF *DERRIS*; *NEOLEPTA BIPLAGIATA*

BY

N. C. E. MILLER,

Assistant Entomologist.

Tuba (*Derris*) is attacked by several species of insects, chiefly moths, the larvae of which are responsible for an appreciable amount of damage to this important crop. The most destructive pest, however, is a small beetle which has been provisionally identified as *Neolepta biplagiata* Jacoby (Fig. 1). This insect is about three-sixteenths of an inch in length and belongs to the family Chrysomelidae, all the members of which feed on the leaves of plants, and not a few of them, in both the larval and adult stages, are very destructive. The adult beetle has shining brown antennae and legs fairly densely covered with pale tawny hairs. The head is dark brown, with a few pale tawny hairs on the front portion. The thorax is brownish yellow and the elytra (wing covers) are pale brownish yellow with an irregular, broad, dark brown band across the front portion, and with the inner and outer margin narrowly dark brown.

FIG. 1. *Neolepta biplagiata* Jacoby, Adult. (Nat. size $^{3}/_{16}$ in.)

The wings, which are slightly visible through the elytra, impart a greyish appearance to those parts of the insect.

The underside of the body is brownish and is somewhat thickly covered with pale tawny hairs, particularly on the abdomen.

When almost full grown, the larva, (Fig 2), is about five-sixteenths of an inch in length. It is whitish, with light brown head and legs, and with a light brown

patch behind the head on the first segment, and another similarly coloured patch on the ninth abdominal segment.

FIG. 2. *N. biplagiata* Jacoby, larva. (Nat. size $^{5}/_{16}$ in.)

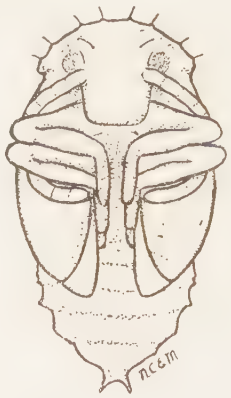

FIG. 3. *N. biplagiata* Jacoby, pupa. (Nat. size approx. $^{3}/_{16}$ in.)

The head, body and legs are sparsely hairy.

The pupa, (Fig. 3), is also whitish, with a somewhat diffused reddish patch on each side of the head, indicating the position of the eyes.

Behind the head are eight low prominences each bearing a hair.

A short time before the emergence of the adult, the pupa becomes greyish in colour.

The pupa is nearly three-sixteenths of an inch in length.

Owing to failure in obtaining eggs of the beetle, either in the field, or from adults kept in the laboratory, an accurate description cannot be given, but it will perhaps suffice if the following rough outline of the appearance of the egg be given. The egg is oval, somewhat elongate and is broadly rounded at the poles. It is creamy white, smooth and shining and is about one thirty-second of an inch in length. This description is based on the results of the examination of a single damaged specimen.

N. biplagiata is destructive while in the adult stage only. It was first reported from Johore in April 1929, when its depredations were giving rise to the opinion that, unless speedily checked, it would bring about the complete destruction of the crop, for although the tuba plant can withstand defoliation once or twice, it rarely, if ever, recovers from the effect of sustained injuries.

The ova are deposited in the soil near the plants, and the larvae on hatching continue to live in the same habitat, and presumably feed on humus.

Both the larvae and pupae are found at a depth of about four inches below the surface of the soil and generally not more than a foot away from the main stems of the plants, but they are also to be found under trailing branches.

As a rule the young leaves are preferred for food, but when they are consumed, the adult turns its attention to the shoots. The damage caused by the feeding of these beetles is conspicuous, the leaves being eaten in an irregular manner, giving them a ragged appearance.

Apart from the sole record made by Mr. F de la Mare Norris of this species feeding on the flowers of *Hibiscus mutabilis* L., there exists no definite information as to its possible alternative host plants, but there is every reason for the belief that such exist in the jungle. Should this prove to be so, the efficacy of measures adopted for control will be, to some extent, lessened, owing to periodic invasions of the beetle.

The danger of invasions can no doubt be mitigated by ensuring that the area chosen for the planting of tuba is as far away as possible from the jungle edge. Nevertheless, even if this safeguard be adopted, there still exists the likelihood of infestation by wind-borne adults.

The control measures which were recommended in the first instance by the Entomological Division of the Department of Agriculture S.S. and F.M.S., were spraying with lead arsenate solution mixed with a spreader such as casein or soap, and hand collecting the adults by means of nets shaped like the usual insect-collecting net, but having the bag made of some stout material instead of mosquito netting, the interior of the bag being smeared with an adhesive substance such as castor oil and resin boiled together.

Both these means were apparently ineffective, perhaps owing to lack of supervision of the personnel employed and to unsystematic spraying, the latter being understandable in the case of one estate, at least, where irregularity of planting and the configuration of the ground possibly militated against efficacy of control. On two estates visited recently, the tuba had been planted out in evenly spaced rows, and on one of these estates spraying operations were being systematically carried out. Two mixtures were in use, one composed of pyrethrum powder, napthalene, fish-oil soap and water, the other containing the same ingredients with the difference that petroleum was substituted for napthalene.

The results obtained, particularly when the latter mixture was used, were highly satisfactory, since it was found that 95 per cent. of the sprayed beetles succumbed. The spray is directed on to the plant from above, whereupon, most, if not all, of the beetles drop to the ground, when they receive a further dose.

On reaching the ground, sprayed beetles begin to run about rapidly and in a confused manner, then, after the lapse of three to five minutes, their movements become slower, and finally, rolling over on to their backs, they expire.

The cost of spraying with these materials is comparatively low, working out at $2/- per acre, exclusive, of course, of expenditure on spraying machines.

An opinion has been expressed, that the cost of spraying might be considerably reduced without loss of efficiency, by the omission of the napthalene or petroleum from the mixture and it is thought that such a mixture is well worth a trial.

It has been noticed that *N. biplagiata* is more abundant after rain has fallen. Although at present one can only theorize on the reason for a sudden increase in the numbers of the pest, it is possible that the softening action of rain on the soil facilitates the emergence of the adults. A hard and parched soil would doubtless assist in retarding emergence from the pupa which is found at a depth of three to four inches below the surface of the soil. A protracted drought, by unduly prolonging the pupal stage, might conceivably destroy a proportion of pupae, particularly any which might be at a greater depth below the surface than is normally the case.

N. biplagiata would appear to have few natural enemies.

The Reduviid bug—*Sycanus leucomesus* Walk., a moderately abundant predator of several other species of insects, however, has been observed by Mr. Norris to attack adults, but as a controlling factor, it is of negligible importance.

No instances of the beetle having been devoured by birds have so far been recorded. As beetles of the family Chrysomelidae are rarely preyed upon owing to their distasteful qualities, assistance from birds in reducing the numbers of this pest should not be expected.

The writer wishes to express his thanks for assistance to the Managers of the estates on which investigations were carried out and to Mr. F. de la Mare Norris, Principal Agricultural Officer, Johore, for much useful information.

THE MUNICIPAL GRANARIES, COLOMBO

BY

B. Bunting,
Agriculturist.

By the kind permission of the Colonial Secretary, Ceylon, the writer visited the Chalmers Granaries and Manning Rice Markets at Colombo, on the 21st February, 1930, with a view to collecting information as to the general working of these large grain stores.

Object of Granaries.

With the object of preventing the outbreak or spread of plague in Ceylon certain rules and regulations were framed under "The Quarantine and Prevention of Disease Ordinance, 1897", which are briefly as follows:—

(*a*) All rice imported at the port of Colombo or arriving in Colombo by train from abroad shall be taken to be stored in the Chalmers Granaries or the Manning Markets or such other place as may be approved by His Excellency the Governor, unless removed from the wharf direct by rail to a place outside Colombo.

(*b*) No grain shall be stored in any place which has not been approved by the proper authority, and any grain stored in any place not so approved shall be forthwith removed by the owner to such place as the proper authority may sanction.

The object aimed at by the establishment of rat-proof granaries and markets is the concentration of the grain trade and its isolation from the slums and thickly populated areas.

Plague is introduced into Ceylon by the importation of plague-infected rat-fleas, and rats carrying such fleas, with the grain cargoes coming from other countries or ports where plague is prevalent.

Since it is neither possible to ensure that cargoes shall be free of rats and disinfected at the port of shipment, nor to deal effectively with grain cargoes in Colombo harbour before landing, the only alternative is to deal with the grain after it has landed. In order to minimise, as far as possible, the danger of any plague-infected fleas or rats escaping, and thereby spreading infection among the local rat population, the grain imports are concentrated in rat-proof granaries from which imported rats cannot escape to infect other rats with the fleas carrying the disease.

The Municipality of Colombo constructed two large rice stores for this purpose. One of these is known as the Chalmers Granaries, which is reserved for the wholesale trade, and the other as the Manning Rice Markets, which is employed solely for the retail trade. The two granaries are separate units,

entirely enclosed, and every facility is provided for the enforcement of strict sanitation and a continuous campaign against rats. Both granaries are the property of the Municipality and are under the supervision of the Chairman, Board of Immigration and Quarantine.

Location.

The two granaries are situated near the Fort Station about a quarter of a mile from the wharf and in the centre of the Municipality. They are, however, about 400 or 500 yards apart and the Chalmers Granaries are connected direct with the railway for convenience of transport. It is essential that such granaries should not be erected adjoining a wharf or on the bank of a river or canal, since the presence of water only serves to introduce rats.

Construction of Granaries.

The following is a brief description of the general construction of the two granaries, the details of which were kindly supplied by the Chairman, Board of Immigration and Quarantine:—

Chalmers Granaries.

The Chalmers Granaries were erected in 1915 at a total cost of Rs. 1,722,195/- and comprise ten warehouses containing in all 119 separate stores of various sizes, with a total storage capacity of 2,991,250 cubic feet or approximately 600,000 bags of rice These granaries cover an area of about 11 acres, including roads.

The warehouses are built of reinforced concrete with a series of span roofs supported by steel trusses with box gutters between.

The average height to plate level (the roof being left open) is 16 feet, the distance between trusses is 15 feet and the clear span of roof trusses is 50 feet.

The buildings are constructed with 14 ins. × 14 ins. reinforced concrete piers on reinforced concrete spread foundations. The external walls are filled in between piers with 9 inch reinforced concrete panels.

The floor is of 4 inch setts, set on top of 6 inch concrete with an additional 6 inch of rubble underneath. It is raised about one foot above ground level and slopes outwards.

The roof is covered with Roman Poilite asbestos tiles fixed to reapers supported by 7 ins. × 3 ins. purlins at about 4 feet centres. The doors are sliding and constructed with small channel and angle-iron framing filled in with heavy gauge corrugated iron sheeting.

The warehouses are sub-divided into stores by 9 inch brick in cement walls up to plate level and the portion above is filled in with wire netting.

An open verandah has been provided in front of each store. An iron guard rail, about 18 inches high, is fixed to prevent carts backing close against verandahs.

The whole of the site is enclosed with a substantial brick wall and the gates, which are closed at dusk, are specially constructed to keep out vermin.

Manning Markets.

The Manning Markets were erected in 1918 at a total cost of Rs. 1,043,976/- for the storage of rice and comprise 59 separate stores with a total storage capacity of 1,024,250 cubic feet, or approximately 200,000 bags of rice. These rice markets cover an area of about $5\frac{1}{2}$ acres, including roads.

The dimensions of the various stores are as follows:—

6	Stores	50	feet	×	50	feet.
15	,,	50	,,	×	25	,,
15	,,	50	,,	×	20	,,
23	,,	25	,,	×	20	,,

The stores are built of brickwork 18 inches thick, with tiled roof, reapers and common rafters supported on framed timber trusses.

The height to plate level is 18 feet 3 inches and the distance between trusses 12 feet 6 inches and the span of trusses 25 feet.

The walls between stores are carried up to the underside of rafters.

The floor is of 4 inches setts on 6 inches concrete with an additional 6 inches of rubble underneath.

Doors are wooden sliding doors and are framed, ledged, braced, and battened.

An open verandah 12 feet 6 inches wide is provided in front of each store.

Method of Rat-Proofing.

The Chalmers Granaries and Manning Markets have recently been rat-proofed and the methods adopted are as follows:—

Walls—The face of walls all round the stores inside were chipped and cement rendered very smooth to a minimum depth of 3 feet 6 inches from the bottom of the roof tie beam. At this level a demarcation band of red paint 3 inches wide runs inside and all round the store. This line is intended to serve as a guide to the merchants in occupation of the stores not to stack their goods above this red line. This consequently reduces the stocking capacity of the store. All angles of walls are rounded in cement mortar and space between wall and roof is filled in with brick in cement and sloped. The open gables are screened with wire mesh screens. This method has since been discovered to be insufficiently rat-proof as the rice merchants ignore the red band and stack the rice to the tie beam level. An experimental screen of asbestos has been constructed in one of the stores.

Doors—A band of cement mortar 3 inches wide is dubbed out on the wall on either side of the opening and an angle iron $1\frac{1}{2}$ inches × $1\frac{1}{2}$ inches × $\frac{1}{8}$ inch is fixed on the top of opening. This is to prevent any space between the wall and the sliding door when the stores are locked.

Windows and Ventilators—Those inside the store have been provided with wire-netted screens and the window sill cement-rendered and sloped.

Gates—These have been rat-proofed by fixing sliding plates 16 feet long working in grooves made with 2 angle irons 3 inches × $2\frac{1}{2}$ inches × $\frac{1}{2}$ inch embedded in cement concrete, the plates being fixed to the gates. This is to check any rats getting in from the ground. The gates are also provided with 3 inches wide iron plates $\frac{1}{8}$ inch thick one on either side of the gates, which check any rats entering from the sides.

Outlets of Down Pipes—All outlets of down pipes are provided with rat guards of iron sheeting 3/16 inch thick.

In addition to the above, great importance is attached to the necessity of preventing any flowers, creepers, palms, bushes, etc., being grown against the walls or being kept in the verandahs.

Lease of Stores.

The various stores are let separately to Rice Dealers on a monthly tenancy at a rental of 6 cents per cubic foot per annum. The tenancy may be terminated by either party giving the other one clear month's notice, but the tenant is required to make a deposit of three months' rent. An extra charge is made for the use of electric light and telephone. Some of the larger stores are provided with small offices and an additional rent of Rs. 5/- or Rs. 10/- per month is charged for single and double offices respectively.

The tenants of the stores are responsible for the cleanliness of their premises.

Regulations of Granaries.

The general rules, framed for the working of these granaries aim at:—

(1) the prevention of escape from the granaries of rats imported with the grain cargoes;

(2) the prevention of access by such imported rats to water without which they cannot live;

(3) the prevention of the infection by these rats or their fleas of human beings by closing the granaries at night and forbidding people from sleeping in the granaries;

(4) the prevention of access to the area of the granaries of local rats by strict sanitary measures and by forbidding the consumption of meals on the premises or the introduction or collection of food and garbage which would attract or harbour local rats.

Systematic trapping of rats is carried on in the granaries and also hunting of rats when the individual stores are being emptied. A mandor and 5 coolies

at the Chalmers Granaries and a mandor and 2 coolies at the Manning Markets are regularly employed on rat-catching. It is stated that, on the average, each gang will catch from 10 to 15 rats daily.

Supervision and Labour.

The following list gives particulars of the overseers and labour employed in the working of the two granaries:—

Chalmers Granaries.

Supervision	...	1 Overseer
Scavenging gang	..	1 Kangany and 10 coolies
Rat-catchers	.	1 Kangany and 5 coolies
Latrine	...	1 Coolie
Night patrol	...	4 Watchmen.

Manning Markets.

Supervision	...	1 Overseer
Scavenging gang	...	1 Kangany and 5 coolies
Rat-catchers	..	1 Kangany and 2 coolies
Latrine	...	1 Coolie
Night patrol	...	3 Watchmen.

In addition to the above, one Rent Clerk is employed in the office of the Chairman, Board of Immigration and Quarantine, solely for the purpose of collecting rents and keeping a record of accounts.

Costs and Returns.

The following particulars show (a) the cost of the buildings, (b) the value of the land, (c) the annual rent recoverable for occupation of stores, and (d) the annual cost of maintenance, which includes ground rent on land, for both the Chalmers Granaries and the Manning Markets:—

	Chalmers Granaries.	Manning Markets.	Total.
	Rs.	Rs.	Rs.
Cost of buildings	1,722,195.22	1,043,976.19	2,766,171.41
Value of Land .	2,967,000.00	267,187.50	3,234,187.50
Total value of rents ..	208,144.20	74,415.00	282,559.20
Actual amount recovered, financial year 1927—28	185,843.46	74,400.00	260,243.46
Total cost of maintenance, financial year 1927—28 ...	12,946.50	12,015.83	24,962.33
Nett amount realised less cost of maintenance, 1927—28 ...	172,896.96	62,384.17	235,281.13
Total rent recovered from 1915 to end of September, 1928 ...	2,243,788.64	468,486.45	2,712,275.09

It will be seen from the above figures that the total cost of the buildings and the value of the land amounts to Rs. 6,000,358.91, whereas the total annual rental, if all the stores were occupied at the present rate of 6 cents per cubic foot per annum, amounts to Rs. 282,559.20. After deducting expenses on account of maintenance, the amount recoverable from rents is Rs. 257,596.87 per annum, but, owing to some of the stores not being occupied, the nett amount recovered during the financial year 1927—28 was actually Rs. 235,281.13. This is sufficient to give an annual return of about 4 per cent. interest on the capital outlay.

Further, it is shown that the total rents recovered since the inception of these Rice Stores in 1913 to the end of September, 1928, amounts to Rs. 2,712,275.09.

General.

It is estimated that approximately 5,000,000 bags of rice pass through these granaries annually, so it will be realised that the project is no small undertaking.

The granaries were constructed essentially for the control of plague, since it is unusual for the rice to be stored in these rat-proof buildings for more than one or two weeks, after which period it begins to lose weight on account of drying.

The authorities do not claim that the system adopted in Colombo is by any means ideal or complete and the Municipality have not yet been able to enforce the regulations as regards the premises of small retail rice dealers who have private grain stores or boutiques in different parts of the city. There is little doubt, however, that the concentration of the wholesale import trade in grain in the Chalmers Granaries and the similar concentration of many of the retail shops in the Manning Markets has been a measure of great sanitary improvement and has assisted materially in keeping Colombo free from any serious outbreak of plague.

Prior to the construction of these granaries and markets the rice stores were scattered all over the city, mainly in the most thickly populated and insanitary areas, which was, naturally, conducive to the rapid spread of infection. As a result of the provision of municipally controlled rat-proof buildings a large majority of these stores have now been closed. It is stated in official reports that, in spite of these precautions, isolated cases of plague do occur in Colombo, but they can be promptly dealt with, while infected rats and fleas can be and are caught in the granaries and destroyed.

The writer wishes to express his indebtedness to Mr. B. G. De Glanville, Chairman, Board of Immigration and Quarantine, Colombo for the valuable assistance accorded to him in the collection of information regarding the lay-out and working of the Chalmers Granaries and Manning Markets.

THE ROLE OF VITAMINS IN STOCK FEEDING.*

BY

J. B. Orr, D.S.O., M.C., M.A., M.D., D.Sc.,
The Rowett Institute, Aberdeen.

There has grown up during the last few years a very extensive literature on vitamins and minerals. This literature consists mainly of technical papers dealing with the results of research, articles in the popular Press, and propaganda by commercial firms who have put vitamin or mineral products on the market. This great mass of literature is confusing, and some of it is apt to be misleading to stock farmers anxious to apply reliable scientific information in practice. The technical papers are written by research workers for the information of other research workers. They deal with results obtained in laboratories, usually with small animals, and nearly always with special diets which would never be used under farming conditions. The results, therefore, do not apply directly to farming practice. Popular articles and propaganda writing, on the other hand, though on the whole fairly accurate with regard to the facts they do state, tend to magnify striking positive results of experiments to the neglect of negative results, which of course, are of little interest to the ordinary reader. They also overlook the fact that the results obtained in laboratories cannot be applied directly to the totally different conditions of practical farming.

Although in some popular and semi-popular writings the immediate practical importance of the results of recent research on vitamins and minerals has been exaggerated, there is no doubt that the information gained in the last 10 or 20 years is of practical value. Indeed, it is now being applied successfully both in human preventive medicine and in animal husbandry. The present article gives a brief account of recently acquired knowledge and indicates its bearing on practical feeding problems. Unfortunately, although so much experimental work has been done, our knowledge of this "newer" aspect of nutrition is still limited, and our ideas are still growing and changing with the fresh results of research. It is safer, therefore, to regard most of this modern work on nutrition as being still in the experimental stage. There will be no certainty with regard to its practical value until it has been tested and applied under farming conditions by experienced stock farmers capable of forming and expressing an opinion. The following account, therefore, especially in so far as it deals with the practical application of the scientific information which has

* Reprinted from "The Journal of the Ministry of Agriculture," Vol. XXXVII, No. 1, April, 1930.

been obtained in research work, should be regarded as an expression of views rather than a statement of fact. The reader should consider the views or statements set forward here in the light of his own practical experience, and if he should think it worth while attempting to apply any of the information in practice, he should do so as an experiment, noting the results with an open and critical mind. There is a great need at the present time for practical experimental work of this kind carried out on farms to test the value of some recent research, and also to serve as a guide for further research effort in laboratories.

Vitamins Generally.—Fresh foodstuffs in the natural state contain, in addition to carbonaceous material, proteins and salts, certain substances and properties termed "vitamins" which are essential for health and growth. An example of these is the antiscorbutic, which is present in fresh fruits and vegetables, and which keeps the body free from scurvy.

One of the most remarkable features of vitamins is the fact that minute quantities produce profound physiological effects. Thus, less than a ten-millionth part of an ounce per day of irradiated ergosterol, a substance which contains Vitamin D in high concentration—if indeed it be not actually Vitamin D itself—is sufficient to keep rats free from the disease which develops in the absence of this vitamin. The amounts of vitamins necessary to maintain health are so small and are so widely distributed in foodstuffs that it is difficult to make up vitamin-free rations. It is usual in vitamin studies to work with synthetic rations, i.e. combinations of specially purified foodstuffs, artificially freed from vitamins.

It is obvious that vitamins do not provide any appreciable amount of energy or heat or of constructive material for the formation of body tissues. Most probably they act by stimulating certain physiological processes. It is possible that they affect the activities of the ductless glands, which produce substances of which small amounts have a profound effect upon growth and health.

Another interesting feature of vitamins is that it has been found astonishingly difficult to isolate them. They can be concentrated in extracts, but as the separation of the vitamins from the other constituents proceeds, the vitamins tend to disappear, or, in other words, the concentrated substance loses its vitamin property.

The vitamins which have been chiefly studied are: Vitamin C, which prevents or cures scurvy; Vitamin B, the absence of which leads to disturbance of the nervous system and the digestive organs; Vitamin A, which is necessary for growth; Vitamin D, which specially affects the metabolism of calcium and phosphorus, and is therefore of importance in the growth of bone; and Vitamin E, the absence of which causes sterility. Recently another vitamin named "G" has been discovered. It appears to have an effect on growth and in maintaining a healthy condition of the skin and mucous membrane of the mouth.

With vitamins should be included the effects of irradiation with ultra-violet light. The invisible light waves beyond the violet end of the spectrum, when directed upon the surface of the body, produce the same beneficial effect as

Vitamin D. When directed on foodstuffs containing a substance known as ergosterol, the foodstuffs acquire the properties of Vitamin D. Ultra-violet light is contained in direct sunlight. It can also be produced artificially by certain kinds of electric lamps.

The chief pathological conditions which develop when the various vitamins are not present in the diet have been indicated above. The evil effects of vitamin deficiency are, however, not limited to these gross disorders. Diets or rations may contain sufficient of any vitamin to prevent the onset of these gross symptoms of disease, but still not contain sufficient for the maintenance of perfect health. Thus a diet may contain sufficient of Vitamin B to prevent the onset of the typical symptoms of beri-beri, but not sufficient for perfect health, and the animal, though not showing the signs of beri-beri might still suffer from imperfect functioning of the digestive organs and a resulting degree of general malnutrition.

Fortunately, all natural foodstuffs are comparatively rich in most of the vitamins. Thus, fruits and vegetables, grass, roots and tubers, are especially rich in Vitamin C. In cereals, Vitamin B is contained chiefly in the seed-coats. Hence, all whole grains or offal are rich in Vitamin B. Green food, such as grass, is rich in all vitamins, and is especially rich in both Vitamin A and Vitamin D. Vitamin E is also widely distributed in foodstuffs.

The danger of vitamin deficiency arises on diets or rations consisting of materials which form only a part of the natural foodstuff, as, for example, wheat flour or polished rice. In both these cases the vitamin is removed in the process of milling. Cooking tends to destroy the vitamins; hence foodstuffs which have been cooked and preserved are, in general, poorer in vitamins than fresh foodstuffs.

Most of the experiments which have been made to determine the amounts of vitamins present in different foodstuffs, or the effects of the absence of vitamins, have been carried out with small animals, e.g. guinea-pigs and rats, fed on special diets consisting of substances from which all the vitamins naturally present in the original foodstuff have been removed or destroyed. The results of these experiments, while of great scientific interest have of course no direct bearing on stock farming, because the kinds of rations used in these experiments would never be used on a farm, and, further, because the requirements, for some of the vitamins at least, are not the same for different species of animals. The only experiments of immediate practical value for stock breeders are those done on farm animals with rations such as would be used on a farm. Fortunately, a number of these have been done. The practical bearing of these may be considered under the heading of the different vitamins.

Vitamin C.—The only animals that seem to suffer to any marked degree from deficiency of this vitamin are monkeys, men and guinea-pigs. There is, therefore, no evidence that it is of great practical importance in stock farming. It has been shown that cattle and poultry do not suffer from deficiency of Vitamin C in the food, and tests with pigs have shown that they can remain in good

health without any sign of scurvy for at least three or four months, though fed on a diet devised to contain as little of the vitamin as possible.

The writer is not aware of any definite tests having been done on horses. On the other hand, he has not seen any reports indicating a wide occurrence of scurvy among them, although many horses are fed for long periods on rations such as hay, oats and other grains which have little or no Vitamin C. It is possible, of course, that though gross signs of scurvy may not appear, deficiency of this vitamin may be the cause of a minor degree of malnutrition which, if long continued, may manifest itself in increased susceptibility to other diseases. It would be interesting to compare the condition and freedom from disease of town horses which regularly receive some foodstuff rich in Vitamin C, e.g. roots or tubers, with others not receiving this, but on an otherwise similar diet.

Vitamin B.—This vitamin, which prevents beri-beri, is so widely distributed in foodstuffs e.g. grass, wheat offal, grains, roots and tubers, that there is little likelihood of a deficiency in any ordinary ration. Further, the results of a number of tests with cattle carried out by Sir Arnold Theiler in South Africa show that it is a matter of considerable difficulty to produce any signs of deficiency of this vitamin in cattle, even with rations specially prepared to be as free as possible from it.

Fowls are especially susceptible to beri-beri, but as the foodstuffs used for poultry consist largely of wheat offal and grains the danger of deficiency of Vitamin B is not great. Yeast is especially rich in this vitamin, and the addition of yeast to poultry rations has been advocated as a means of providing a rich supply. Yeast is rich in protein and mineral matter, which are required in large amounts by laying hens. The addition of yeast to ordinary rations is likely to be of value, even though an additional supply of Vitamin B is not required, but in tests carried out with well-balanced rations containing sufficient protein and mineral matter, the addition of yeast to the ration was not accompanied by any increase in eggs or better health in the fowls.

Vitamin A. and D.—The two vitamins which seem to be of greatest importance in stock farming are Vitamin A, which promotes growth, and Vitamin D, which promotes healthy growth of bone. For a time Vitamin D was not recognized as a separate entity from A, and the earlier tests were done with substances such as cod liver oil and green food, which contain both. They may therefore be considered together.

Of the two, Vitamin D is probably the more important. Young animals fed indoors in winter are liable to have a diet deficient in D, with resulting imperfect bony development. It has been shown that if chickens be reared indoors without any sunlight and with no green food they are liable to develop "leg weakness," which is believed to be due, partly at least, to deficiency of Vitamin D. In the same way young pigs after weaning are liable to suffer from rickets, a disease in which there is imperfect development of the bones, and which is liable to occur in young pigs fed indoors on cereal rations.

One of the richest sources of Vitamins A and D is cod liver oil, and the

addition of a small amount of this oil to the rations of chicks and young pigs reared in confinement has proved of very definite value in keeping them free from these diseases. Green food, which is rich in Vitamins A and D, will, of course, have the same effect in promoting health. As has been noted above, ultra-violet light, which is available in the sunshine, supplies or replaces the necessary Vitamin D. A run outside, therefore, is in many cases as valuable as feeding substances rich in Vitamin D. It should be noted that fowls kept under ordinary conditions, with an outside run on grass get all the Vitamins A and D they need. Extensive tests have shown that the addition of cod liver oil to rations otherwise well balanced produces no increase in egg yield if fed to fowls kept under ordinary practical conditions with a run on pasture, as most fowls on farms are. In intensive methods of poultry farming, however, when fowls are kept continuously indoors with no green feed, the addition of cod liver oil to the extent of 2 to 4 per cent. of the ration would probably have a beneficial effect. Tests in the United States have shown that the addition of cod liver oil resulted in increased egg yield, and increased hatchability of eggs and viability of chicks.

Vitamin E.—Experiments with Vitamin E, which is believed to affect reproduction, have been carried out only on rats. Whether or not deficiency of this vitamin affects reproduction in farm animals is unknown. On the whole, as Vitamin E is so widely distributed among foodstuffs, it is unlikely that under ordinary conditions a marked deficiency would occur. Arising out of the work on Vitamin E with rats, however, sprouted oats have been tried in the treatment of sterility in cattle in America, and to a less extent in this country. There appears to be some doubt as to whether sprouted oats contain Vitamin E, but the experiments made, although inconclusive, indicate a possible beneficial effect. It is said that fertility has been restored to infertile bulls and the number of services required by cows reduced.

It will be seen that, as far as our knowledge goes, with the exception of Vitamin D, there is not much likelihood of deficiency of vitamins occurring in practice. If, however, deficiency of vitamins be suspected in some rations, vitamin-rich foodstuffs are constantly at the farmers' hand. Green grass, grains, roots and tubers, are easily available. If he wishes something in addition to these, cod liver oil as a supply of A and D, and yeast as a supply of B, can easily be obtained. A dessertspoonful of cod liver oil per head per day should supply sufficient vitamins A and D for large animals, and 4 oz. per 10 lb. of mash are sufficient for fowls. There is no need whatever for any stock feeder to purchase any highly priced foodstuffs merely on account of the fact that they are alleged to be specially rich in vitamins.

NOTES ON OIL PALMS IN ANGOLA.*

The article is accompanied by a map of the territory between 4° and 17° southern latitude and between 12° and 24° eastern longitude shewing the oil palm areas.

The territory naturally falls into three zones: the coastal zone, the hillslope zone, and the upland plains zone. The chief climatic difference is the comparative dryness of the coastal zone in contra-distinction to the heavy rainfall in the other zones.

In the coastal lone, the oil palm grows spontaneously between 4° 41′ and 12° 20′ southern latitude and under cultivation as far south as 13°; exclusively along the river banks or alluvial humus-containing sand or loam soils, but never on marshy soils.

In the hill slope zone, soil and climate are suitable, but the competition with other forest trees prevents the oil palm from dominating the forest. The soil is predominantly a humus-containing clay loam.

In the upland plains, except in a few areas, the oil palm is rarely found, and never above 4,000 feet in altitude. In this area, its growth is much slower than in the lower zones.

Nearly all known varieties of *Elaeis guineensis* Jacq. and of *Elaeis Poissoni* E. Annet, are found in Angola. Mention is made of a variety of the latter that apparently has not yet been found elsewhere in Africa. The name *E. Poissoni* Var *dura virescens nigrescens* is proposed for this variety. According to Janssens and Amaral, the fruits on the outside of the fruit bunches of this variety are black with an orange or green patch at the side turned away from the light. The fruits inside the bunch are orange coloured, with a green base and a green tip; some of these fruits are orange all over and others are orange with violet strips. The sterile carpels forming the sheath are white at the base, green in the middle and violet at the tip. The theory is advanced that this is not a type but a cross between *nigrescens* and *virescens* varieties.

As in other parts of Africa, the varieties *sempernigra* and *communis, forme dura* are most prominent.

Analyses show that the fruit of the oil palms in Angola is very similar to that of the palms in other parts of Africa. The analyses of the fruit of *Elaeis Poissoni,* var. *tenera negrescens* demonstrate that in the matter of selection of high yielding types, evidently there is still a great deal of work to be done.

It is estimated that in the coastal zone, the average annual yield per palm in the natural palm forests is 7 to 9 kilograms of palm oil and 4 to 5 kilograms of kernels. Though in the coastal zone and on the hill slopes the palms bear

*An abstract of a translation of "Renseignements sur se Palmier à Huile en Angola" par C. de Mello Geraldes. From Anais do Instituto Superior de Agronomia—Vol. III. Lisbonne, 1929.

fruit throughout the year, harvesting can only be done during 8 to 9 months per year.

As elsewhere in Africa, the bulk of the produce exported from Angola comes from native holdings. The number of European proprietors and estate factories, however, is increasing. These estates exploit not only natural forests but are establishing plantations from nursery grown seedlings.

One company "Fomento Geral de Angola" is especially mentioned as planting on its estates exclusively the variety *communis* type *tenera* and the varieties of *Elaeis Poissoni*.

A comparison between varieties with a thick shell and those with a thin shell, especially in respect of the vitality and productivity of the various types under natural conditions, leads to the conclusion that selection should aim at establishing a thin shelled type of high oil percentage which would offer the advantage of simplifying the mechanical processes of extraction and separation and of improving the final results.

The figures of exports of both palm oil and of kernels from Angola from 1910 to 1928 show that the annual production varies greatly; for palm oil the variation is from 901 tons to 4,630 tons and for kernels from 4,370 tons to 8,588 tons. For neither product is there any tendency towards steady increase or decrease. Kernels form about two-thirds of the total export though the yield of palm oil per palm is about twice as much as the yield of kernels.

PINEAPPLE BRAN.*

The origin of some feeding stuffs is, to say the least, unusual, and it may be taken that pineapple was not suspected by many readers as providing the source of a very useful material. In the process of canning these fruits, the cores and trimmings which are discarded, are extracted and, by a special drying process, are converted into a palatable dairy and stock food. At the cannery of the Hawaiian Pineapple Cannery, Honolulu, all the waste in the form of skin, defective pieces, cores and trimmings is washed in pineapple juice and screened. The material is next conveyed to the sugar mill, which expresses the juice from the skins and cores, and it is then run through shredders and blown into a revolving drier 8 feet in diameter and 30 feet in length. Here it is thoroughly dried by hot air, and, as the drum slowly revolves, the bran is worked to the discharge ends by means of baffles. As it is discharged from the drum, it passes into a special machine which removes any metallic pieces it may contain, and the bran is then sacked in 100 lb. bags. On analysis, this pineapple bran shews a protein content of 3.62 per cent., with 1.01 per cent. of oil, 18.23 per cent. of fibre, 20.66 per cent. of sugars, 42.16 per cent. of other carbohydrates, and 3.7 per cent. of ash or mineral matter. Although the Hawaiian Pineapple Company only began manufacturing this bran some six years ago, it is stated in *Foodstuffs* that the demand exceeds the supply.

*From—*The Fertiliser Feeding Stuffs and Farm Supplies Journal*, July, 23rd, 1930.

Reviews.

The Biological Control of Insect and Plant Pests.

BY

W. R. Thompson, Ph.D., D.Sc.

Issued by the Empire Marketing Board, June, 1930. Printed and Published by His Majesty's Stationery Office, London. Price 1s. net.

This publication is the first Report on the organisation and progress of the work of Farnham House Laboratory.

The Laboratory, situated about 2 miles from Slough, was founded by the Imperial Bureau of Entomology (now the Imperial Institute of Entomology) in 1927 by means of a grant from the Empire Marketing Board. Its principal object is the furtherance of the control of insect pests of agriculture and forestry in the British Empire by what is known as the biological method; that is, by means of beneficial parasites and predators. The work commenced in June, 1927, and up to the end of June, 1930, requests for parasites and predators of seventy injurious insects had been made. In addition to the above, investigations on the insect enemies of certain weeds were taken over at the request of the Government of the Dominion of New Zealand.

The Report is divided into five parts of 124 pages consisting of:—I. An Introduction, II. The Principles and Organisation of Work on Biological Control, III. Farnham House Laboratory: its Resources, Equipment and Staff, IV. Practical Work and V. Bibliography.

A general account of the way in which work on biological control is planned and executed at the Laboratory is given in Part II in order to convey some idea of the principles underlying it and of the technique used in practical work.

The first section deals with the Principles of Biological Control. The practice of biological control owes its origin to the fact that a great many injurious insects and plants are attacked by parasitic and predacious species belonging to the same group and further, many plants injurious to agriculture and forestry have also their insect enemies. Then insect pests which are accidentally imported to new countries leaving their habitual parasites and predators behind, frequently become extremely numerous and cause immense damage, for experience has repeatedly shown they are generally attacked to only a negligible extent by the beneficial species existing in their new homes. Of the 183 worst insect pests existing in North America, almost half have been introduced, mostly from Europe. In former times no regulations existed that were designed to prevent the importation of insect and plant, but as transport was very slow and no means of preserving foodstuffs existed, opportunities for the migration of injurious insects were not really very numerous; but the development of world trade has permitted and fostered cosmopolitan tastes and requirements which in turn further stimulate commerce between the various parts of the globe. The increase in the development of world trade has thus, as a necessary consequence, caused an increase in the rapidity of the dispersion of pests.

A discussion concerning the disadvantages of mechanical control follows. As an instance, in certain parts of the world, the amount of arsenic used during the ordinary treatment against the Codlin Moth in apples is so great that the arsenical residue on the fruit at the time that it is gathered is dangerously large and has to be removed by special processes, so that in view of the cost of and the repeated applications of poisons and similar methods of control, entomologists are now attempting to utilise the parasitic and predacious enemies which attack injurious insects in nature.

The Hawaiian Planters' Association and the United States Bureau of Entomology have for a long time maintained a special staff of entomologists to deal with the biological control of insects. Until quite recently, work on biological control of insects within the British Empire has not been actively pursued. In Australia and New Zealand the effort to bring injurious plants under control by phytophagous insects is now being carried out on a more comprehensive scale than in any other part of the world.

Further subjects discussed in this Part are concerned with preparatory work dealing with the importance of the correct identification of insects and of a bibliographical service; a preliminary field survey; the careful examination of the material which has been collected in order to decide that the insects are really parasitic or predacious on the pest to be studied; and the choice of the species to be utilised in which the habits, especially the reproductive rate, will influence the final selection. In this Section the subject of miscellaneous introductions of parasites which may come into conflict with each other in the field is discussed.

Following the section dealing with the Choice of Species is a section treating with large scale collection and shipment in which are discussed the introduction of parasites either at first by breeding from a small stock collected in the field or by collecting large numbers of the parasite in its native home. Each method has its advantages and disadvantages and depends very largely on the habits of the species to be introduced. Further sections have most useful information concerning the Methods of Treatment on Reception, the Study of the Progress of Introduced Parasites in the Field and the Results of Experiments in Biological Control.

Part III of the Report deals with Farnham House Laboratory, and is divided into sections dealing with Finances, Grounds, Buildings and Equipment and Staff.

In his summary to this Part, the Author points out the necessity for the development of work on biological control in view of the fact that the basic foodstuffs of Europe are of fundamental importance to its colonies and that the insect pests of the plants and animals utilised in Europe are, therefore, amongst the most important in relation to the agriculture of the Empire. The situation of the Imperial Institute of Entomology is, it is claimed, the most convenient possible in that it enables such investigations as are necessary to be conducted with greater efficiency, rapidity and more cheaply than would be the

case if investigators from the Dominions and Colonies had to proceed to Europe to carry out the particular work affecting their territory. The mobile and flexible organisation visualised is stated to be in a better position to seize opportunities for practical work than are agents sent especially from distant points.

In connection with these claims the reviewer is not entirely in agreement. One cannot preclude the desirability of workers in one country visiting other countries—perhaps far distant—in connection with such problems. That this view is also held in other countries is shewn, for instance, by the fact that the United States Bureau of Entomology, the Fiji Government, and the Hawaii Sugar Plantations still consider it necessary to send representatives to Malaya and near-by countries without previous knowledge of those countries to investigate parasites of various insects and to superintend the selection, the breeding and the transportation of parasites.

The section dealing with the practical work undertaken up to the present time describes the various practical operations together with the methods which have been employed in particular cases and the results which have been obtained to date.

This section deals with Parasites of Deciduous Fruit Insects; Parasites of Forest Insects; Parasites of Cereal and Forage Crop Insects; Parasites of Insects of Vegetable and Garden Crops; Parasites of Tropical Field Crop Insects; Parasites of Citrus Fruit Insects; Parasites of Greenhouse Insects; Parasites of Insects affecting Man and Domestic Animals; Investigations in the West Indies, concerning parasites of sugar cane borers and Noxious Weed Work which comprises the utilisation of insects to control noxious weeds of European origin in New Zealand.

In addition to the above series, theoretical studies on the problem of natural control are being conducted.

Up to the date when this publication was sent to the press, a total of 73 consignments of beneficial insects, containing approximately 285,000 living individuals have been sent out of the Laboratory and in these shipments 24 species of beneficial insects attacking 17 species of pests have been included.

Most of the projects deal with insects in the Dominions, Canada, Australia and New Zealand, and the names of Tanganyika, Uganda and Kenya are missing from the list. It is conceivably possible that these colonies in future will have their own parasitic station to deal with the principal pests.

Altogether a most practical and informative report having a distinct interest not only to the entomologist but also to the general public.

The staff has every reason to be proud, with the enormous number of parasites it has dealt with in such a comparatively short time, and the public will welcome the publication of this concise statement setting forth the achievements of the Imperial Institute of Entomology for the biological control of pests in the British Empire.

G.H.C.

Prospectus of the Government School of Agriculture, Malaya.

The Government School of Agriculture, Malaya, situated at the Government Experimental Plantation, Serdang, about 14 miles by road from Kuala Lumpur, will, it is anticipated, commence work in May, 1931. The Prospectus which has just been published states that there is, at present, accommodation for eighty students. Such students are arranged in four groups, viz: Agricultural Students in Training, i.e. Asiatics who have been appointed by Government with a view to subsequent employment as Agricultural Assistants in the Department of Agriculture; Agricultural Pupils, i.e. Asiatics who have been appointed by Government with a view to subsequent employment as Agricultural Subordinates in the Department of Agriculture; Scholars, i.e. students to whom scholarships have been awarded either by Government or by non-Government institutions or persons; and Private Students, i.e. students other than those described above.

The principal course of instruction, covering a period of three years, is conducted in English and provides a scientific training in Tropical Agriculture, with special reference to local conditions. The minor course, lasting one year, is conducted in the Malay language and provides a practical training in the agriculture of the major crops of the Malay Peninsula.

The Prospectus gives full details regarding the appointment of Agricultural Students and Pupils and the admission of Private Students, together with the syllabus of instruction in respect of each course.

The School was designed primarily for the training of the Asiatic staff of the Department of Agriculture. Hitherto, such instruction has been conducted at Kuala Lumpur under somewhat inadequate conditions. With the provision of the new School, to which is attached a Hostel in which all Students are expected to reside during term, it is anticipated that not only will the course more adequately fill the needs of the Department of Agriculture, but that by the inclusion of Private Students, a long felt want in Malaya will be satisfied. Asiatics own land and manage estates—some of considerable area—which in the aggregate embrace the greater part of the agricultural activity of Malaya. It is thought that the provision of this School, where for the payment of moderate fees, the sons of well-to-do Asiatics can obtain a grounding in scientific agriculture and its practical application in Malaya, will be appreciated by parents who may desire that their sons shall assist, intelligently, in the management of their property.

Copies of the Prospectus may be obtained free on application to the Director of Agriculture, Kuala Lumpur, F.M.S.

D.H.G.

THE SECOND INTER-DEPARTMENTAL AGRICULTURAL CONFERENCE, KUALA LUMPUR.

The Second Inter-Departmental Conference was held at Kuala Lumpur under the Chairmanship of Dr. H. A. Tempany, Director of Agriculture, S.S. & F.M.S., from October 27th—November 1st, 1930 inclusive. In addition to the officers of the Department of Agriculture, the following departments took part in the Conference: The Rubber Research Institute of Malaya, the Co-Operative Department and the Veterinary Department.

The Hon'ble the Chief Secretary to Government, F.M.S., Mr. C. W. H. Cochrane, C.M.G., opened the Conference with a speech in which he shewed as well as voiced his interest in the Department of Agriculture and his confidence in the value of the Conference. In the course of his speech, Mr. Cochrane announced that he appreciated the necessity of more adequate buildings for the Department, in consequence of which provision for new buildings was included in the 1931 estimates. He had watched with interest the development of the Department for the past thirty years, and although during the early years attention was devoted mainly to rubber, in latter years the Department's sense of proportion had become adjusted and the scope of these activities had been widely extended, with excellent results. Moreover, the Department was in touch with and had the confidence of the public, which was beginning to realise that success in agriculture was derived from the application of scientific principles to the many problems with which it was confronted.

The Chairman after thanking the Chief Secretary for his speech outlined the objects of the Conference as follows:—

To assist in defining departmental policy.

To discuss and classify details in relation to various points of this policy.

To promote contact between the field staff and the research staff of the Department of Agriculture and to secure better understanding of the relations of the work of these and other branches; and

To facilitate contact and discussion between the branches of the Department and other Departments of the Government service as well as the Rubber Research Institute, in relation to common lines of work.

The former Conference he described as a business gathering and he wanted to emphasise that in organising the present one the business aspect of the proceedings had again been kept in view.

As the result of the last Conference a series of decisions was arrived at in relation to a number of lines of work. It was interesting to record that practically without exception these had been translated into action during the past twelve months.

Dr. Tempany proceeded to review the development of work during the year. Much of this development was assisted by the findings of the previous

Conference. Closer contact existed between the field and research divisions and the scope of the former division was now more clearly defined.

A scheme of re-organisation of the work of the department had been submitted to Government and in framing these proposals the findings of the previous Conference were of great assistance. The standardisation of the departmental exhibits at all agricultural shows in Malaya was a further outcome of the last Conference.

Without attempting to anticipate or to review in advance the nature of the discussions in the present Conference, the Chairman pointed out the importance of such subjects as were included in the programme under padi, statistics, and in particular, the commercial and economic aspects, which were of particular interest to the Department of Agriculture and the Co-operative Department.

Alluding to stock, Dr. Tempany welcomed particularly the representatives of the newly-constituted Veterinary organisation of the Government. The exact part of any stock policy which might hereafter devolve on the Department of Agriculture and the Veterinary Department respectively remained to be decided, but there was no question that the interests of the two organisations were closely interwoven and he was hopeful that the inclusion of stock problems in the work of the Conference and the attendance of the representatives of the Veterinary Department would be as productive of satisfactory results as already had been co-operation between the Department of Agriculture, the Co-operative Department and the Rubber Research Institute.

The remainder of the morning session of the Conference was devoted to the consideration of schemes in relation to demonstration plots, and details of the lay-out of such plots; standardisation of work in school gardens and the manner in which instruction should be given; measures for the destruction of rats; and the work of Chinese Sub-Inspectors of Agriculture and the desirability of extending these services to parts of the Peninsula where at present they do not exist.

In the afternoon, a sub-committee considered subjects concerning questions of internal economy in the Field Division.

The Tuesday Session of the Conference was devoted to questions in relation to padi cultivation. In this connection the following papers were submitted.

"Some recent application of statistical methods"	...	by Mr. R. G. H. Wilshaw.
"Experiments on padi"	...	by Dr. H. W. Jack.
"Measures to be adopted for the distribution of selected strains of padi seed together with a survey of results achieved to date in padi distribution"	...	by Dr. H. W. Jack.

"Recent views on general characteristics and standard methods of treatment of padi soils"	...	by W. N. C. Belgrave.
"Mechanical cultivation of rice"	...	by Messrs. C. L. Newman and J. Lambourne.
"Recent work on padi stem borers"	...	by Messrs. G. H. Corbett and H. T. Pagden.
"The collection of statistics in relation to the padi crop"	...	by Mr. J. Gordon-Carrie.

As will be seen from the above titles the production of rice was reviewed from many points of view. Questions of soil selection, seed selection, manuring and control of pests were discussed; and the importance of improvement in methods of collecting statistics was considered and eventually referred to a sub-committee. This committee reported its recommendations, which were adopted, at the last session of the Conference.

The possibility of producing padi on a large scale was emphasised not only by the paper prepared by Messrs. Newman and Lambourne, but by the account of the successful cultivation by means of modern machinery in South Siam. The latter account will be found in this number of *The Malayan Agricultural Journal.*

In the afternoon the delegates visited the Coconut Experimental Station, Klang.

Wednesday, October 29th was devoted to Rubber. Papers introducing discussions were as follows.—

"The application of bud-grafting to kampong conditions"	...	by Mr. C. E. I. Mann.
"Co-operative Rubber Societies among Malay small-holders"	...	by Mr. F. G. Spring.
"Preparation of rubber from the point of view of small-holders"	...	by Mr. R. O. Bishop.
"Oidium and Mouldy Rot with special reference to small-holdings"	...	by Mr. F. Beeley.
"Difficulties of the control of pests and diseases in the field"	...	by Mr. F. de la Mare Norris.
"The chemical manuring of rubber"	...	by Dr. C. F. Flint.

From the above, it will be seen that the problems considered were mainly in connection with the cultivation of rubber on small-holdings. The chief point that emerges from these papers and the discussions is the reliance which both the Department of Agriculture and the Rubber Research Institute place in educational means of various descriptions to induce the small-holder to improve his methods of cultivation and to guard against the dangers of pests and diseases, rather than on legislation.

Later, the delegates inspected the Rural Lecture Caravan, inaugurated by the Departments of Agriculture and Co-operation and the Rubber Research Institute which will constitute a travelling exhibition and from which lectures and educational cinematograph shows will be given.

In the afternoon, a visit was paid to the headquarters of the Rubber Research Institute where the delegates witnessed a demonstration of sulphur spraying methods and inspected the laboratories.

Thursday, October 30th, was devoted to problems concerning coconuts, oil palms, tea and pineapples, and in addition agricultural problems in Johore and Kedah. Two papers on the agricultural problems of Pahang East and Singapore were, on account of pressure of time, held over till the Saturday session.

The morning programme of subjects was as follows:—

"Cultivation of coconuts on heavy soils with special reference to soil type, water table, plant food requirement"	by Mr. W. N. C. Belgrave.
"The present day position in relation to copra research and practical issues concerned therewith" .	by Mr. F. C. Cooke.
"Insect pests of the coconut palm" ...	by Mr. G. H. Corbett.
"Some practical considerations in relation to the cultivation of the oil palm"	by Mr. B. Bunting.
"Tea and other crops in Ceylon and India" ...	by Mr. E. A. Curtler.
"Proposals for the establishment of experimental work on pineapples in Singapore" ...	by Mr. J. W. Jolly.
Agricultural Problems in—	
(a) Pahang East ...	by Mr. J. M. Howlett.
(b) Johore ...	by Mr. F. de la Mare Norris.
(c) Kedah ...	by Mr. W. N. Sands.
(d) Singapore	by Mr. J. W. Jolly.

In the afternoon papers on agricultural co-operation among small-holders by Mr. F. G. Spring, and Government produce purchase schemes by Dr. H. A. Tempany were the subjects for discussion.

A good deal of interesting discussion was provoked by the papers and it is believed that they serve to some extent to clarify the position.

The consideration of Government produce purchase schemes was the subject of much discussion in which the arguments for and against were stated, and the relationship of such schemes with the work of the Co-operative Department was emphasised. A sub-committee was formed, consisting of representatives of the Department of Agriculture, the Co-operative Department and the Rubber Research Institute to consider the advisability of adopting such a scheme and its application to the larger native agricultural industries of Malaya.

Live Stock questions were considered at the Friday sessions.

Mr. B. Bunting read a paper on "Cattle at the Government Experimental Plantation, Serdang" which gave an account of the work performed at that Station in relation to the improvement of dairy cattle.

Dr. Tempany described the progress of dairying work in Malaya and pointed out the scope which exists for local milk production. He described the various efforts in relation to Government dairies in other Colonies with which he was familiar and indicated that no real difficulty existed in Malaya in the way of producing milk equal to the best grade milk sold at Home.

In the subsequent discussion, considerable divergence of opinion was found to exist as to the desirability or otherwise of making crosses the basis for the improvement of milk in Malaya.

The control of disease, including that of piroplasmosis was discussed, and it was stated in East Africa control of this and even more deadly diseases had been attained by various methods.

Mr. R. McGregor opened a discussion on the buffalo problem in Pahang. He pointed out the importance of the buffalo in the economy of the ryot, its hardiness and value as a milk producer. He put forward certain suggestions for the improvement of the buffalo and indicated that the best line would be the establishment of a Government stud-farm where improved breeds of buffaloes could be raised, the stationing of bulls in selected country districts with a view to improving the breed and the elimination of the practice at present prevailing of breeding from unsatisfactory sires.

Mr. Bunting opened a discussion on the improvement of pigs in Malaya referring to the pig breeding work and experience gained at the Government Experimental Plantation, Serdang.

In the subsequent discussion attention was given to the dissemination of information amongst Chinese agriculturists in relation to breeding of pigs, the desirability of arriving at a type of pig acceptable to the local market and the elimination of unsatisfactory sires.

The concluding paper of the morning session dealt with the breeding of sheep in Pahang, Captain Howlett describing efforts in progress in Pekan to improve the breed of sheep on the East Coast. The East Coast is the only part of Malaya where sheep-raising has been undertaken satisfactorily and some of the difficulties incidental to the work were described.

The suggestion was made that it might be possible to introduce a type of sheep common in Nigeria, as a possible means of improving the size and grade of the sheep native to the East Coast.

Incidentally, it was mentioned that the cognate subjects of goat-rearing and poultry raising required attention. It was stated with regard to both, that the subjects were under consideration by the Department of Agriculture, which, however, as yet made no definite pronouncements on either.

The afternoon session was devoted to the question of plant quarantine measures in Malaya. The subject was opened by Mr. F. W. South, who

summarised the existing measures and stated the difficulties inherent in their application and made suggestions for possible improvements.

After considerable discussion it was resolved that a certain number of points were indicated for improvement in the existing services. It was decided that it was necessary to decide upon the plants and the pests and the diseases against the introduction of which it was essential that Malaya should protect itself and that the necessary steps should be taken to ask for effective quarantine measures in respect of these particular plants and pests.

The final session of the Conference was held on Saturday morning, November 1st, at which Mr. Sands read his paper on agricultural problems in Kedah and Mr. Jolly on the problems of Singapore. Extensional work in the Unfederated Malay States was considered in the discussion of the former paper; while the dependence of Singapore on importations of fruits and vegetables from Java and Sumatra was stressed in the discussion of Mr. Jolly's paper. It was urged that at the present time this import trade represented a huge export of capital from Malaya, a considerable part of which could be kept in the country, but that efforts were needed in order to bring this about.

The arrival of some means of estimating bark consumption on small rubber holdings formed the final subject for discussion. Many difficulties in this connection were discussed. Finally, an inter-departmental committee was appointed to consider the matter further and to make recommendations for a satisfactory system of making these measurements.

Upon the conclusion of this subject, a number of resolutions and reports emanating from the earlier work of the various committees were laid before the Conference and after discussion, adopted.

These resolutions dealt with the following points:—

(i) The organisation of work on School gardens.

(ii) The desirability or otherwise of prescribing a "close" season in relation to rat destruction measures.

(iii) Various points in relation to the duties of sub-inspectors, especially in relation to the collection of statistics and other work.

(iv) The transport of Malay Officers on duty and monthly reports of subordinate officers.

In the course of the Chairman's concluding address, he stated that the Conference had covered a very wide field and expressed the view that when the results came to be examined, it would be found that a very great deal had actually been accomplished.

In the afternoon a number of the delegates visited the Government Experimental Plantation, Serdang.

The delegates foregathered in the evening at a Conference Dinner.

CRABS IN PADI FIELDS.*

In North Kedah and Perlis, there occurs a small crab *Paratelphusa Sexpunctatum,* Lanceaster, which is found in large numbers in the padi fields and is very destructive to seedlings in the nurseries and also to those newly planted out. The crab appears to remain in the areas throughout the year, but does not breed rapidly or cause much injury to the padi plants except at the commencement of the season. It is a small, dark-brown species with a carapace (shell) when fully grown measuring from 1½ to 2 inches at the widest part and about 1½ inches long.

According to the Director of the Raffles Museum, the natural enemies of this crustacean are rats; the other (*Lutra leptonyx* Horsf.), king-fishers, some birds of prey and waterfowl. The peasantry in the Districts infested rely to some extent on ducks to keep the young of the pest in check; they also capture large numbers by hand. Poisons such as carbon bisulphide and calcium cyanamide have been placed in the small holes of the crab found in the bunds, but these, although effective, are far too expensive and dangerous to be placed in inexperienced hands.

In the Year Book of the Madras Department of Agriculture for 1927, there was published an article by K. Venkataraman which gives an account of the damage done by crabs in padi fields in Madras and also a description of experiments that were made in the endeavour to control them. The following is an extract from that article which applies equally well to local conditions.

> "Crabs cause serious damage to padi crops. They destroy sprouting seedlings in the nurseries with the result that there is a dearth of seedlings for transplanting, and they also cut down newly planted seedlings in the fields. The latter form of trouble often becomes serious, rendering it necessary to fill up gaps caused by the destruction of plants; this entails delay, additional worry, and an unnecessary reserve of seedlings. Crabs also make holes through the bunds of the fields, and, in one night, a field may be completely drained of water through the holes so made. In times of shortage of water, fields thus drained may not be refilled for several days, with the result that the crop is damaged. Where the pest is serious, coolies may have to be engaged to go round the bunds filling up the holes, and the expense of this is not inconsiderable.
>
> "It has been noticed that crabs find suitable conditions and do the greatest damage, only in fields which remain under water, They can be got rid of either by employing coolies to catch them by hand, or by setting up crab traps in the fields. The former method is costly and subject to the availability of labour; whilst the other is inexpensive,

*Memorandum by W. N. Sands, Principal Agricultural Officer, Kedah.

simple, and self-acting. The following is a brief description of how to set up a crab-trap.

"A wide-mouthed ordinary mud-pot (chatty) is buried in a corner of the padi field so that the mouth of the pot is just flush with the level of the soil in the field. The mouth of the pot should be 4—6 inches wide and the pot itself about 12 inches in diameter at its widest part. The pot is baited with two handfuls of well-fried rice-bran moistened and made into large lumps for convenience in handling. In frying no oil is necessary, and the frying should be stopped when the bran becomes aromatic. If the whole field is under water, the pot also will fill with water; this, however, will not wash out the bait as wet bran quickly settles to the bottom of the pot. The smell of the rice-bran attracts the crabs which drop into the pot and are held captive there because the sloping convex neck of it effectively prevents all means of escape. The same bait may be allowed to remain in the pot for two days without detriment to the efficiency of the trap. Various other baits such as wheat-flour, powdered ground-nut cake, and fish-meal have been tried, but rice-bran gave the best results. Usually five or six crab-traps are enough for an acre plot, and these may be restricted with advantage to the vicinity of field bunds which harbour numerous crab-holes. Both the initial expense of the pots and the cost of renewing the bait are trifling. The crabs in the pots should be removed daily and destroyed."

In one District of Kedah where the damage done by crabs was so severe that whole fields of plants were completely destroyed, experiments were made following the lines of those described above. In one experiment five large pots, known to the Malays as 'buyong', were baited with rice-bran and sunk at intervals near to the bund of a field of about three-quarters of an acre in area in which newly planted padi had been totally destroyed. The result was as under.

Date.	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.	Total Caught.
28-8-30	21	18	21	25	35	120
29-8-30	15	30	35	28	15	123
30-8-30	1	9	11	2	2	25
31-8-30	4	6	6	4	18	38
					Total =	306

The pest was so reduced in numbers after four days that the pots were removed to another field for demonstration purposes. This field was about one acre in size and had also been badly damaged.

The results obtained here were as follows:—

Date.	Pot 1.	Pot 2.	Pot 3.	Pot 4.	Pot 5.	Total Caught.
1-9-30	5	12	19	27	10	73
2-9-30	4	23	6	5	12	50
3-9-30	5	10	12	11	6	44
4-9-30	3	5	10	7	5	30
					Total =	197

The fields were replanted in each case a few days later and no further noticeable damage resulted. In the latter case, however, the experiment was continued as invasions from neighbouring fields were to be anticipated, but the average number captured daily over a period of 10 further days was 6 per pot per day only.

It should be noted that a cracked or slightly damaged pot is just as effective as a good one and that the pots can usually be purchased at the pottery for a few cents only as against the cost of 20 to 25 cents for a sound utensil. Rice-bran is also obtainable locally in the shops at a cheap rate, namely, about 13 cents per gantang, whilst a certain quantity is obtained from siftings of home milled rice.

The trials already made with crab control in Kedah indicate that the species which occurs there can be readily and inexpensively kept in check by the use of large mud-pots, but in order to prevent damage the traps should be put lown in infested areas at the commencement of the season, that is, as soon as rain falls or the lands are irrigated.

OBITUARY.

Sir Francis Watts, k.c.m.g.

At the commencement of the Conference Session on November 1st the Chairman announced the death of Sir Francis Watts, K.C.M.G., late Principal of the Imperial College of Agriculture, Trinidad, which occurred on 27th September, 1930. He moved a resolution of regret on the occasion and of sympathy with the relatives of the deceased gentleman, referring to the services rendered by him to the cause of tropical agriculture during his long and distinguished career. The resolution was carried by the Conference standing.

The death of Sir Francis Watts removes one who was personally known to many in this Department. Those of us who have had the privilege of working with or under Sir Francis Watts regard him with great respect and affection. Officers of the Department of Agriculture, S.S. & F.M.S. feel that by his death not only does tropical agriculture lose a great figure but that many of us lose a personal friend, and almost all of us engaged in this science lose one who in one way or another has influenced their career and stimulated their work by his example and experience.

FROM THE DISTRICTS.

The Weather.

There was an ample and well distributed rainfall in all parts of the country throughout the month.

Remarks on Crops.

Rubber.—The price of rubber remained much the same as in the previous month; smoked sheet from small holdings sold for $10 to $17 and unsmoked sheet from $8 to $15.50 a picul. In Province Wellesley a number of holdings remained untapped while their owners were engaged in padi planting, since the primary importance of growing food supplies is now becoming more generally recognised. Wet weather and the continued low price have caused a further increase in the number of untapped small holdings.

The favourable damp conditions caused a recrudescence and spread of Mouldy Rot disease, as was anticipated; in most centres control measures have been well maintained. The occurrence of Oidium leaf fall in Province Wellesley was definitely recorded for the first time. Three estates experienced slight attacks at the beginning of the month, but the fungus disappeared when rainfall became heavy and continuous.

Padi.—Suitable weather caused a marked improvement in the growing padi throughout the country, even in areas previously affected by drought. It also enabled good progress to be made in localities where planting operations have only recently become possible. The general prospects of the season's padi crop are now considerably better than they were at the end of September.

Army worms appeared generally on the padi nurseries throughout Province Wellesley but were controlled by flooding or by the use of tuba solution.

Food Crops.—In Pahang West the Malay small-holders, perhaps as a result of past experience, grasped quite early in the year the importance of building up a good supply of food-stuffs to supplement their padi should the latter prove unsuccessful. In consequence, maize, tapioca and various vegetables have now been harvested and are available in abundance. New areas continue to be planted as fast as the old areas are harvested. In most mukims it would seem that the improved prospects of the padi crop, the extensive area of hill padi planted and the large supplies of maize and other food-stuffs available should secure the population against any serious shortage of food in the coming year.

In Negri Sembilan also the number of small vegetable plots planted in the holdings continued to increase and the demand for maize seed and tapioca cuttings was large; few Malay visitors to the Seremban Demonstration Station left without a large bundle of tapioca cuttings and a supply of maize seed of the popular Salisbury White variety.

Notes on Demonstration Station and Padi Test Plots.

Bukit Merah Test Plot, Province Wellesley.—The quarters, store and office for the Padi Inspector have been completed and are now occupied; a permanent buffalo shed is in course of erection and a bridge and well are under construction. Transplanting of the padi from the nurseries is about to commence.

Rat Destruction.

In Province Wellesley payments were made for 39,282 rat tails and 41,113 baits were distributed. In Krian 179,006 rats were destroyed. In each centre the rats accounted for since the commencement of the year now exceed 1,000,000. It has been decided to reduce the reward for tails from 1 to ½ cent each on and after the 1st of November.

DEPARTMENTAL NOTES.

Visit of H.H. The Regent of Kedah to the Serdang Plantation.

H.H. The Regent of Kedah visited the Government Experimental Plantation, Serdang on 14th October, 1930.

Visit of Mr. C. O. Oates to Malaya.

Mr. C. O. Oates, Agricultural Officer, Kenya Colony is on a visit to this Department. Mr. Oates will report to his Government on agricultural matters in this country and will forward a certain amount of plant material for trial in Kenya Colony.

The Second Inter-Departmental Agricultural Conference.

An account of the Conference is included in this number. The Conference has given an opportunity for the officers of the Field Division to discuss various matters with the technical staff and has thus had a value apart from the actual Conference Sessions.

Demonstrations to Chinese at Serdang.

A demonstration to Chinese Agriculturists was given at the Government Experimental Plantation, Serdang on October 8th, 1930.

Leave.

Mr. F. S. Ward, Assistant Mycologist, returned from leave of absence on 3rd October, 1930.

MARKET PRICES.

October 1930.

Rubber.—The market price of rubber appreciated slightly during the month. The lowest price recorded in Singapore was 11¾ cents per lb. on the first two days of the month, the highest price 14¼ cents on the 30th. The average price for the month in Singapore was 12.6 cents; in London 3.96d., compared with 12.8 cents and 4.09d. respectively in September.

Palm Oil.—On November 4th, London advised that the price of palm oil was on that date £16.17.6 C.I.F. per ton on a basis of 18% F.F.A.

Copra.—Singapore copra prices showed some recovery towards the end of the month. Average October prices were: Sundried, $6.22, Mixed, $6.02 per picul compared with $6.57 and $6.39 in September. Copra cake averaged $1.90 against $2.13 in September. Market has advanced on improved demand and "short" covering. Supplies are moderate.

Gambier.—Singapore prices have remained steady at $9.37½ for block; $14.25 per picul for cube No. 1. Corresponding average prices in September were $9.70 and $14.35. Little demand, but supplies limited and prices remain steady.

Nutmegs.—Local prices for nutmegs show some improvement. 110's averaged $29.40; 80's $32.70 compared with $25 and $29.20 per picul in September. Market for nutmegs and mace firm due to an improved Continental demand and a shortage of supplies.

Mace.—A sharp rise is recorded in the Singapore prices during October. Siouw averaged $90.50, Amboina $67.50 per picul. The corresponding prices in September were $63.80 and $39.90.

Pepper.—Singapore average prices in October were: Black $24.80; White, Rio and Sarawak, $39.00; Muntok, white, $41.00 per picul. In September the corresponding prices were $21.45; $30.50; $31.40. Market steady with moderate business passing.

Sago.—Singapore average prices for October: Flake, small, fair, $6.19 per picul; Flour, Sarawak, fair, $2.99 against $6.22½ and $2.96 respectively in September. Reports at the end of October state that supplies are temporarily short and there is a good demand at higher prices for near delivery.

Tapioca.—October average prices in Singapore were:—Flake, small, fair, $4.24; Pearl, seed, $5.65; Pearl, medium $5.95. Corresponding prices for the previous month were respectively $4.13; $5.42½; $5.75. Latest report states that the market is fair with sellers inclined to hold off.

Pineapples.—Average prices in Singapore for October: 1½ lb. cubes, $3.40; 1½ lb. sliced, flat, $3.34; 1½ lb. sliced, tall, $3.76 per case. In Septem-

ber the average prices were $3.80; $3.68; $4.20 respectively. Demand moderate at very low prices.

The above market prices are based on the daily cabled London quotations and the Singapore quotations for rubber; on the Singapore Chamber of Commerce Market Reports from October 4th—November 1st, and on other local sources of information. Palm oil quotations are kindly supplied by Messrs. Lewis and Peat (S'pore) Ltd.

1 picul = 133 1/3 lbs.

The dollar is fixed at two shillings and four pence.

NOTE.

The Department of Agriculture will be pleased to assist planters in finding a market for agricultural products. Planters of some of the minor agricultural products frequently experience difficulty in getting into touch with buyers. It is thought that in such cases the assistance of the department may be of particular value to producers.

MALAYA RUBBER STATISTICS.

STOCKS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX HELD BY DEALERS AND ESTATES OF 100 ACRES AND OVER, THE DECLARED PRODUCTION OF THE SAME ESTATES, IMPORTS AND EXPORTS, AND THE ESTIMATED PRODUCTION OF ESTATES OF LESS THAN 100 ACRES, FOR THE MONTH OF SEPTEMBER 1930, IN DRY TONS.

Territory	Stocks at beginning of month			Production by estates of 100 acres and over		Production by estates of less than 100 acres (estimated)		Imports				Exports (including re-exports)				Stocks at end of month		
								during the month		during the year 1930		during the month		during the year 1930				
	Ports	Dealers	Estates of 100 acres and over	during the month	during the year 1930	during the month	during the year 1930	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Dealers	Estates of 100 acres and over	Ports
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
MALAY STATES																		
Federated Malay States	...	10,302	15,382	13,198	101630	10,078	84,947	Nil	5	Nil	52	16,384	6,028	137920	48,870	10,594	15,959	...
Johore	...	2,609	5,297	3,984	31,274	3,116	35,119	Nil	Nil	Nil	14	1,200	6,213	9,272	58,037	2,013	5,040	...
Kedah	...	475	2,387	2,233	17,240	546	10,941	Nil	Nil	30	Nil	1,056	2,341	6,676	21,624	436	2,208	...
Perlis	..	7	8	7	74	5	114	Nil	Nil	Nil	Nil	Nil	9	Nil	202	10	8	...
Kelantan	...	144	108	363	2,285	304	3,384	1	Nil	31	Nil	79	501	628	5,091	182	158	...
Trengganu* ...	...	55	50	127	1,051	63	525	Nil	Nil	Nil	Nil	Nil	190	Nil	1,577	55	50	...
STRAITS SETTLEMENTS																		
Malacca	...	2,461	1,951	1,330	10,648	† 3,260	30,131	Nil	2,906	Nil	15,592	4,626	Nil	35,013	Nil	2,606	1,957	...
Province Wellesley	...	145	702	567	4,054			381	3,303	6,863	30,083	5,961		50,244		131	709	...
Dindings	...	117	191	101	882											89	145	...
Penang	1,197	5,953	14	12	94											5,266	15	1,876
Singapore ...	1,680	32,637	340	250	2,054			6,296	9,068	81,519	89,660	20,677		184,299		28,526	324	4,954

ANALYSIS OF COLONY, FEDERATED MALAY STATES AND JOHORE DEALERS' STOCKS AT END OF MONTH, IN DRY TONS.

Class of Rubber	Federated Malay States	Singapore	Penang	Province Wellesley, Dindings and Malacca	Johore	Gross total
(20)	(21)	(22)	(23)	(24)	(25)	(26)
Smoked sheet ...	7,865	14,551	3,500	1,788	898	28,602
Crepe	518	12,328	1,203	700	240	14,989
Unsmoked sheet ...	1,195	1,647	563	338	511	5,634
Scrap and lump ...	1,016				364	
Total all Grades ...	10,594	28,526	5,266	2,826	2,013	49,225

Notes.—1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.

2. The production of estates of less than 100 acres is estimated from the formula: Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month; i.e., Column (7) = Columns (13) + (14) + (17) + (18) + (19) — (2) — (3) — (4) — (5) — (9) — (10).

3. Colony Dealers' Stocks are as published in Return I. & E. 6, dated 17 Oct., (S. S. *Gazette* Not. No. 2111), being dry weight as estimated by Dealers themselves.

4. Malay States Dealers' Stocks are reduced by the following excl ratios. Unsmoked Sheet, 15%; Wet Sheet, 25%; Scrap, Lump, etc., 40%.

5. Foreign Imports are as published in Return I. & E. 5, date October 3, (S. S. *Gazette* Not. No. 2054), foreign wet imports being reduced to dry weight by 25 per cent.

6. Foreign exports of each State and Settlement are those published in the Malaya Monthly Trade Return (Appendix II), and are distinct from Ocean-Shipments as published in Return I. and E. 4, dated October 3, *Gazette* Not. No. 2053 Appendix IV to Monthly Trade Return).

*7. Stocks and production in Trengganu are estimated from figures supplied by the Commissioner of Lands.

8. All statements are brought up to date monthly and any inaccuracies that may be disclosed are corrected in the totals; the latest publication, therefore, is always the most reliable.

†9. This hypothetical figure, based on the formula quoted in Note 2, contains whatever errors exist in the Columns comprising it and may therefore be expected to fluctuate from month to month. A truer indication of production will be the monthly average over as long a period, for which figures can be estimated, as possible.

Singapore October 18, 1930.

J. I. MILLER, M.C.S.,
Acting Registrar-General of Statistics, S.S. and F.M.S.

SUMMARY OF PADI REPORTS, FEDERATED MALAY STATES AND STRAITS SETTLEMENTS, FOR THE MONTH OF SEPTEMBER, 1930.

State	District	Acreage of padi land	Acreage planted	Percentage 4 to 3	Gross crop	Crop per acre 6 to 4	Remarks
		Acres	Acres		Gantangs		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perak	Perak North :						
	Krian	53,250	...	...	...	...	About 16,000 acres planted clearing of land completed over all mukims, except Selinang and Gunong Semonggol where clearing has begun.
	Larut	8,525	...	...	...	...	About quarter of the area planted. Clearing completed over the rest.
	Selama	3,450	...	...	...	...	About two-thirds of the area planted. Clearing complete. Planting nearly completed. Owing to lack of water padi tugal—not nurseries—has been planted in Bruas, Blanja, Layang, Boka, Lambor Kiri, and Kanan 6,900 acres.
	Kuala Kangsar	13,977	...	...	...	...	Planting nearing completion.
	Upper Perak	3,739	...	...	...	...	Clearing in progress.
	Perak South :						
	Eight mukims	14,817	...	...	...	...	Areas in two more mukims have now been included.
		97,778	...	...	...	...	
Pahang	West :						
	Temerloh	12,311	...	...	...	...	1 to 4 months planted. Flowering stage in some areas.
	Raub	5,112	...	...	...	...	Transplanting still in progress.
	Kuala Lipis	8,450	...	...	...	...	River mukims 1—4 months. Rest transplanting in progress.
	Bentong	1,100	...	...	...	...	Up to 2½ months old. { Acreage of padi land revised.
		26,973	...	...	...	...	
Negri Sembilan	Seremban	4,904	...	...	...	...	Transplanting and weeding in progress.
	Kuala Pilah	17,931	...	...	...	...	Transplanting and weeding in progress
	Port Dickson	159	...	...	...	...	Transplanting and weeding in progress.
	Jelebu	3,116	...	...	...	...	Transplanting completed.
	Tampin	2,609	...	...	...	...	Planting nearly finished excepting in Gemas and Tampin Tengah where planting has not yet commenced owing to lack of water.
	Rembau	7,897	...	...	...	...	Transplanting and weeding in progress.
		36,616	...	...	...	...	

SUMMARY OF PADI REPORTS, FEDERATED MALAY STATES AND STRAITS SETTLEMENTS, FOR THE MONTH OF SEPTEMBER, 1930.—(Continued).

State or Settlement (1)	District (2)	Acreage of padi land Acres (3)	Acreage planted Acres (4)	Percentage 4 to 3 (5)	Gross crop Gantangs (6)	Crop per acre 6 to 4 (7)	Remarks (8)
Selangor	Ulu Langat	2,670	...	...	...	...	Transplanting completed. Water drained off in Kajang and Ulu Langat.
	Kuala Lumpur	797	...	...	...	...	Transplanting completed except in Sungei Buloh. Water drained off in Kuala Lumpur.
	Ulu Selangor	1,205	...	...	...	...	Transplanting completed.
	Kuala Selangor	18,564	...	...	...	...	Tanjong Karong and Sekenchau—694 acres—abandoned.
		23,236	...	...	...	...	Transplanting completed in Jeram 4710. Other mukims have not yet been visited.
Straits Settlements	Malacca, Central	16,473	...	...	...	...	Planting almost completed.
	Alor Gajah	11,136	...	...	...	...	Planting almost completed.
	Jasin	5,756	...	...	...	...	Transplanting in progress.
		33,365	...	...	..	...	
	P. Wellesley, North	18,560	...	...	...	...	Ploughing and planting in progress.
	Central	10,519	...	...	...	...	Clearing still in progress. All nurseries sown.
	South	4,643	..	...	...	..	Clearing still in progress. All nurseries sown.
		33,728	...	...	...	...	
	Penang	4,060	...	...	...	...	Planting almost completed.
	Singapore	nil	...	...	...	...	

N.B.—The figures given in the latest return under column 3 may be accepted as more accurate than any given in previous returns.

METEOROLOGICAL SUMMARY, MALAYA. SEPTEMBER, 1930.

Locality	Air Temperature in degrees Fahrenheit							Earth temperature		Rainfall									Bright Sunshine			
	Means of			Absolute Extremes						Total		Most in a day	Number of days						Total	Daily Mean	Per cent	Length of Day
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation*	Precipitation, 1mm. or more	Thunderstorm	Thunder heard	Fog morning obs.	Gale force 8 or more				
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.							hr.	hr.	%	hr.
Railway Hill, Kuala Lumpur, Selangor ...	91.5	71.7	81.6	96	69	83	74	83.3	83.9	5.12	130.1	1.68	12	8	1	10	2		166.95	5.57	46	12.1
Bukit Jeram, Selangor ...	90.6	72.7	81.7	94	70	85	75	87.3	88.3	2.97	75.5	0.83	13	10	...	14	9		201.85	6.73	56	12.1
Sitiawan, Perak ...	90.4	71.7	81.1	93	67	86	74	84.3	84.5	5.33	135.4	1.25	13	11	7	14	...		195.60	6.52	...	...
Kroh, Perak ...	85.1	68.5	78.8	88	64	79	71	80.3	82.4	9.79	248.7	1.98	16	12	...	6	2		175.50	5.85	...	...
Temerloh, Pahang ...	91.3	72.1	81.7	95	69	86	75	85.5	86.4	3.89	98.8	1.41	13	10	4	18	5		178.70	5.96	49	12.1
Kuala Lipis, Pahang ..	90.2	71.4	80.8	94	69	87	74	84.5	84.5	3.22	81.8	1.38	11	8	12	20	21		173.45	5.78	...	...
Kuala Pahang, Pahang ...	87.8	73.8	80.8	92	72	85	77	86.6	88.0	3.95	100.3	1.23	14	13	15	18	...		223.50	7.45	62	12.1
Cameron's Highlands, Rhodendron Hill, Pahang ...	71.7	59.0	65.3	79	57	64	61	...	...	11.79	299.5	3.72	19	15	3	11	1		161.70	5.39	45	12.1
Cameron's Highlands, Tanah Rata	72.3	55.2	63.7	76	46	66	61	70.2	69.8	10.60	269.2	2.84	16	15	3	13	...		156.55	5.22	43	12.1
Fraser's Hill, Pahang ...	74.3	61.9	68.1	79	60	70	63	70.9	71.6	7.09	180.1	2.42	13	12	..	7	8		169.30	5.64	47	12.1
Mount Faber, Singapore ...	87.6	75.4	81.5	92	71	81	79	83.3	84.4	8.76	222.5	3.40	12	9	1	15	..		164.40	5.48	45	12.1
Butterworth, Province Wellesley	87.3	73.3	80.3	91	70	81	75	85.1	85.2	12.03	305.6	2.49	18	16	1	9	...		187.55	6.25	...	...
Bukit China, Malacca ...	84.8	73.2	79.0	87	71	82	76	83.6	84.8	9.95	252.5	1.90	22	18	2	4	...	1	198.00	6.60	55	12.1
Kluang, Johore ...	88.2	71.0	79.6	93	69	81	74	81.5	82.3	6.41	162.8	1.70	17	15	1	9	7		152.20	5.07	42	12.1
Bukit Lalang, Mersing, Johore...	89.4	72.1	80.7	93	70	80	75	82.3	82.6	3.09	78.5	1.17	17	13	4	22	1		183.40	6.11	55	12.1
Alor Star, Kedah ...	86.7	73.8	80.3	90	71	77	77	85.1	86.0	9.41	239.0	2.58	17	15	...	2	...		174.40	5.81	...	...
Kota Bharu, Kelantan ...	89.0	73.3	81.1	91	70	87	75	85.3	85.5	6.67	169.4	1.24	16	13	...	12	...		186.85	6.23	...	...
Kuala Trengganu, Trengganu...	88.7	73.1	80.9	92	71	86	75	84.4	84.9	4.67	113.9	1.82	15	10	1	17	1		210.95	7.03	...	...

* Precipitation ·01 inch or more when measurement is in inches ·2mm. or more when measurement is in millimetres.

Compiled from Returns supplied by the Meteorological Branch, Malaya.